

NUCLEAR SCIENCE ABSTRACTS

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GENERAL

4036

ATOMIC ENERGY AND ITS APPLICATIONS. J. M. A. Lenihan. New York, Pitman Publishing Corp., 1954. 265p.

A simple account is presented of the physical foundations of nuclear science and their applications. Topics discussed include atomic structure; waves and atoms; radioactivity; nuclear structure; detection and measurement of nuclear radiations; particle accelerators; nuclear reactions; nuclear fission; nuclear reactors; atomic weapons; production of radioactive nuclides; protection from radiation hazards; medical applications; industrial and scientific applications of radioactive materials; and future prospects of atomic energy. (C.H.)

RESEARCH PROGRAMS

4037 AECL-168

Chalk River Project (Canada)

STATEMENTS ON CANADA'S ATOMIC ENERGY PROGRAM. [1955]. 12p.

4038 BNL-303

Brookhaven National Lab.

ANNUAL REPORT—JULY 1, 1954. 145p. Contract AT-30-2-GEN-16.

This annual report of Brookhaven National Laboratory describes its program and activities for the fiscal year 1954. The progress and trends of the research program are presented along with a description of the operational, service and administrative activities of the Laboratory. The scientific and technical details of the various research and development activities are covered more fully in scientific and technical periodicals and in the quarterly scientific progress reports and other special reports of the Laboratory. Hence the activities of the Laboratory service organizations are treated more fully in this report whereas research activities are covered in summary. (auth)

4039 BNL-326

Brookhaven National Lab.

QUARTERLY PROGRESS REPORT [FOR] OCTOBER 1–DECEMBER 31, 1954. (UNCLASSIFIED SECTION). 56p.

Summaries of papers submitted for publication are presented. Acceleration Development. Progress in the design and construction of the electron analogue and alternating-gradient synchrotron is reported. Reactors. Studies of the resonance widths of various levels in nuclei were continued. The radiation width parameter, γ , was investigated for the first three slow neutron resonances of $\text{Eu}^{151}(n,\gamma)\text{Eu}^{152}$, and variations were found from level to level. A dependence of neutron spin state upon entering the nucleus is considered as a possible cause for the observed variation. The β -ray spectrum of He^6 was determined, yielding a Fermi plot which is linear to 750 kev and an end point at 3.48 ± 0.05 Mev. Instrumentation and Health Physics. Design of liquid level recorder and

magnetometer is described. The value of W , the energy expended per ion pair, was measured for air, N_2 , O_2 , CO_2 , CH_4 , A, and C_2H_4 . Good agreement was obtained with previous work except for A, where impurities were found responsible. Threshold detectors were used to obtain a rough estimate of the Cosmotron neutron spectrum at two locations. Medicine. The affect of small ^{131}I doses on selected rat tissues was studied. Rats on thiouracil developed thyroid adenomas, and in one animal a tumor was found with a blood invasion. Three pituitary adenomas weighing ~ 250 mg were found in Long-Evans rats that had received $400\text{ }\mu\text{C}$ of ^{131}I about 18 months previously. Acute thiouracil treatment lowered the thyroidal accumulation of At^{211} in rats. Other experiments suggest that the thyroid gland selectively accumulates $\text{Re}^{186-188}$. The distribution of Cu^{64} -labeled copper-protoporphyrin in normal and tumor-bearing mice showed that the injected compound disappeared rapidly from the blood and concentrated (in decreasing order of concentration) in liver, spleen, lung, tumor, and skin tissue. Successful results have been obtained from a technique for measuring blood flow in body organs by a radioxenon external counting technique. Serial electrocardiographic tracings were obtained in 8 patients given intravenous injections of large amounts of boron as part of the neutron capture therapy treatment for brain tumors. Consistent uniform electrocardiographic abnormalities were found in all patients. These results are thought to be due to appreciable concentrations of intracellular boron, leading to cell anoxia. The acute toxicity of boron administered intravenously as borax was studied in mice. The dose for 50% lethality was determined for several experimental conditions. (For preceding report in series see BNL-314.) (K.S.)

BIOLOGY AND MEDICINE

4040 AERE-Lib/Trans-512

ELECTRON-MICROSCOPIC INVESTIGATIONS OF THE CHANGES WITH AGE IN THE MEDIA OF THE HUMAN AORTA. Willy Schwarz. Translated by F. Hudswell from Virchow's Arch. pathol. Anat. u. Physiol. 324, 612-28(1954). 15p.

AEROSOLS

4041 AD-41950

[Chemical Corps], Camp Detrick

THE DETERMINATION OF VIABLE PARTICLE SIZE DISTRIBUTION. A NEW APPLICATION OF THE CONIFUGE. INTERIM REPORT NO. 73. Frank R. Olson and John F. Lee. June 1954. 29p.

The conifuge is a conical centrifuge with the internal air flow so arranged that particles are deposited on the inner surface of the outer cone according to their mass, with the heavier particles deposited at the upper end. Application is described of the conifuge to determining

viable particle size distribution of a biological aerosol. Experiments are described which demonstrate the usefulness of the new method in studying the performance of various atomizers and the effects of various suspending fluids on particle size of biological aerosols. (C.H.)

4042 BNL-2284

Brookhaven National Lab.

SAMPLING PERIODS IN AIR POLLUTION EVALUATIONS.

Maynard E. Smith and Irving A. Singer. Mar. 15, 1955.

22p. Contract [AT-30-2-Gen-16]. To be submitted for publication in National Air Pollution Symposium.

The analysis of a single, typical case of air pollution taken from the Brookhaven oil-fog runs illustrates the fact that sampling periods are extremely important in air pollution studies. It is clear from the data presented that errors of a factor of 10 or more may arise from the choice of improper sampling periods. Instrumental and location errors are seldom as serious as this. Caution is recommended both in the interpretation of field samples and in the prediction of concentration values by means of diffusion parameters because they are functions of time. The time scale that has to be considered depends completely on the particular problem. The use of power spectrum analysis promises to be of considerable assistance in the selection of the proper sampling periods. (auth)

RADIATION EFFECTS

4043 AMRL-175

Army Medical Research Lab., Fort Knox

ADAPTATION TO IONIZING RADIATION. A. T. Krebs

and John B. Storer. Feb. 2, 1955. 17p.

The literature on acquired radioresistance has been reviewed briefly. A definition of adaptation and criteria for the evaluation of experiments has been proposed. Theories of mechanism were discussed. Original studies on unsuccessful attempts to adapt mice to total-body radiation were reported. It was concluded that adaptation does occur in certain tissues but that considerably more information is required before the significance and possible importance of the phenomenon can be evaluated. (auth)

4044 BNL-2255

Brookhaven National Lab.

THE EFFECT OF CHRONIC GAMMA RADIATION ON THE PRODUCTION OF SOMATIC MUTATIONS IN CARNATIONS. Alan Richter and W. Ralph Singleton.

[1955]. 13p.

Carnations grown under conditions of chronic gamma radiation produced somatic mutations which can be vegetatively propagated. These mutations are white to red flowers, red to variegated and standard double to single flowered types. For somatic mutations produced on flowers during radiation, it is not possible to state whether there is a linear relationship between mutation rate and dose rate. In one variety, Harvest Moon, there is a strong indication of an exponential relationship but the other two varieties show no significant deviation from a linear relationship. (auth)

4045 UR-385

Atomic Energy Project, Univ. of Rochester

A COMPARISON BETWEEN BARE AND BLACKENED PORCINE SKIN IN RESPONSE TO PULSES OF HIGH INTENSITY RADIANT THERMAL ENERGY. George

Mixer, Jr. Mar. 11, 1955. 15p. Contract W-7401-eng-49.

The median effective exposures for 2+ burns in pigs were determined for energy pulses of various lengths on bare skin and skin blackened with India ink. The ratio $2+ EE_{50}$ (blackened)/ $2+ EE_{50}$ (bare) was found to have a mean value of 0.413 for the shorter exposures; this ratio is time-dependent and increases with longer exposure times. It was discovered that there is a discrepancy between the absorbed doses necessary to produce 2+ burns in bare and blackened skin, as determined from their measured total reflectances. It is shown that this difference is of a significant magnitude, and its cause is attributed to the diathermancy, or translucency, of porcine skin. (auth)

4046

RADIATION BIOLOGY. VOLUME II. ULTRAVIOLET AND RELATED RADIATIONS. Alexander Hollaender, ed.

New York, McGraw-Hill Book Co., Inc., 1955. 593p.

Biological effects of ultraviolet and related radiations are discussed by various authorities in the field. Each chapter is supplemented by an extensive bibliography, and subject and author indexes are included. (For Vol. 1 see NSA 9-1719.) (C.H.)

4047

LEUKEMOGENESIS BY IONIZING IRRADIATION. J. Furth and A. C. Upton (Oak Ridge National Lab., Tenn.). Acta Radiol. Suppl. **116**, 469-76(1954).

The major essential findings of recent research on leukemogenesis by ionizing irradiation are surveyed. All types of ionizing radiations are leukemogenic, the induction rate varying with the total dose, dose rate, interval at fractionation. The leukemogenic action of irradiation is markedly influenced by partial shielding, genetic and physiologic factors. Three sets of new experiments in mice are summarized. The leukemogenic effect of instantaneous massive whole-body irradiation from nuclear detonation of a large population of genetically uniform adult mice is being studied. The induction of lymphomas within 16 months is high (14 to 16%) after doses above the LD_{50} dropping rapidly with smaller doses, being negligible below 400 rep. The leukemia-inducing action of thermal neutron-gamma irradiation was essentially identical to that of roentgen irradiation and included induction of myeloid, as well as lymphoid leukemias. Cortisone appeared to reduce the incidence of lymphomas and possibly also of myeloid leukemia in mice when given in certain time relation to irradiation, there being marked differences with respect to sex. (auth)

RADIATION HAZARDS AND PROTECTION

4048 UR-308

Atomic Energy Project, Univ. of Rochester

AN EXPERIMENTAL APPROACH TO THE STUDY OF THE RESPIRATORY DEPOSITION AND RETENTION OF CERTAIN ALPHA EMITTERS. P. E. Morrow and Louis J. Casarett. Jan. 10, 1955. 25p. Contract W-7401-eng-49.

The plan of experimentation being undertaken for the purposes of investigating factors relevant to respiratory tract deposition and retention of certain airborne α emitters and providing animals with established amounts of α emitters in their respiratory tracts for toxicological study is described. All special instruments and equipment which have been developed in this particular program are described. (auth)

4049 UR-310

Atomic Energy Project, Univ. of Rochester

PERSONNEL PROTECTION IN THE RADIOACTIVE IN-

HALATION PROGRAM. G. Hoyt Whipple, J. N. Stannard, G. J. Miller, M. L. Ingram, and T. T. Mercer. Feb. 4, 1955. 40p. Contract W-7401-eng-49.

This report summarizes measures taken to adapt standard radiation protection practices to a special laboratory for inhalation exposure studies using alpha or beta emitting isotopes. It includes calculations of waste water activities which can be released into the Genesee River, and maximum amounts of radioactive materials permitted outside of dry boxes. Special features include protective clothing, self-contained breathing equipment, background hematological information on the personnel in the group, and the application of monitoring procedures to a laboratory handling radioactive aerosols. (auth)

4050 UR-384

Atomic Energy Project, Univ. of Rochester
THERMAL PROTECTIVITY OF A LIGHT PONCHO MATERIAL. George Mixter, Jr. Mar. 29, 1955. 15p. Contract W-7401-eng-49.

The critical energy of a light weight waterproof material was determined with the fabric suspended in air. The protective qualities of this fabric against radiant thermal energies was then determined, using white pigs as the indicator. Protectivity was determined for trapezoidal energy pulses of 0.6 and 5.0 sec with fabric in contact with, and 5 mm separated from, the pig's skin. In contact with skin this poncho material increased the severity of burn; at 5 mm separation the protective index was determined to be 4.71 at 0.6 sec and 1.67 at 5.0 sec. (auth)

4051 USNRDL-TR-29

Naval Radiological Defense Lab.
RECOVERY FROM ACUTE RADIATION INJURY IN MICE FOLLOWING ADMINISTRATION OF RAT BONE MARROW. L. J. Cole, J. G. Habermeyer, and V. P. Bond. Jan. 19, 1955. 24p.

Rat bone marrow suspension injected into lethally x-irradiated mice resulted in up to 50 per cent survival after 30 days, whereas none of the controls (injected with buffer) survived. A relatively large percentage of late deaths, i. e., between 2 weeks and 2 months after irradiation, was observed among the mice treated with rat bone marrow. In some experiments, the irradiated mice received injections of cortisone in conjunction with bone-marrow treatment. The data suggest that the administration of cortisone may enhance the protective effect of rat bone-marrow in x-irradiated mice. (auth)

RADIOTHERAPY

4052

A METHOD OF DOSIMETRY FOR CARCINOMA OF THE CERVIX UTILIZING A MODIFIED MANCHESTER TECHNIC WITH COBALT 60. I. Meschan, T. H. Oddie, and George Regnier (Univ. of Arkansas School of Medicine, Little Rock). *Radiology* 64, 546-59(1955) Apr.

It is felt that for the purpose of comparison of the results of treatment of carcinoma of the cervix, treatment should be individualized for each patient. To this end, certain anatomical fixed points are defined, to which the treatment is directed. A new applicator is described, together with the reasons necessitating its design. A summary of the method of treatment of the four stages of spread of carcinoma of the cervix is included. A typical clinical problem is evaluated, and a long and short method of dosage calculation are demonstrated. (auth)

4053

THE PHYSICAL ASPECTS OF THE UTILIZATION OF THE TRIPARTITE RIGID COBALT 60 APPLICATOR FOR THE TREATMENT OF CARCINOMA OF THE CERVIX. T. H. Oddie and I. Meschan (Univ. of Arkansas School of Medicine, Little Rock). *Radiology* 64, 560-6(1955) Apr.

By means of special dosimetry tables and radiographs corrected for magnification, it is possible to obtain the gamma roentgen contribution to any point in the pelvis. By predicated certain fixed relationships between a specially designed rigid applicator and these pelvic points, an ideal distribution of radioactivity in each capsule of this applicator has been determined. Optimal capsular strength for each capsule is indicated and a method of adjusting the Co⁶⁰ intensity within the capsules to these optimal strengths is described. For a symmetrical application in an average pelvis, a short method of calculating the dosage delivered to these pelvic points is derived and presented. (auth)

TOXICOLOGY STUDIES

4054 MLRR-351

Chemical Corps Medical Labs., Army Chemical Center
TOXICITY OF SODIUM BOROHYDRIDE, TRIMETHYL BORATE, LITHIUM BOROHYDRIDE, POTASSIUM FLUOBORATE AND SODIUM HYDRIDE. Colborn T. Blaisdell. Mar. 1955. 14p.

The toxicity of sodium hydride and lithium borohydride is low. Sodium borohydride causes severe lesions on coming in contact with slightly moist skin. The intrinsic toxicity of potassium fluoborate is relatively low. Injury to the skin or penetration of the skin by either trimethyl borate or potassium fluoborate is negligible. (auth)

4055 UR-392

Atomic Energy Project, Univ. of Rochester
THE ACUTE TOXICITY AND RETENTION OF ORALLY ADMINISTERED POLONIUM²¹⁰ IN THE RAT. R. J. Della Rosa, R. G. Thomas, and J. N. Stannard. Apr. 8, 1955. 11p. Contract W-7405-eng-49.

The acute toxicity of orally administered Po²¹⁰ in the rat has been studied. It is concluded that there is no marked difference in toxicity of Po after gavage as compared with an equivalent body burden after intravenous administration. This occurs despite differences in tissue distribution and kinetics of excretion. The whole-body retention up to 120 days after a single oral dose is adequately described by a single exponential relation to time, with half-time of about 42 days. By contrast, after intravenous administration, the loss occurs in two phases with half-times of about 30 days and 60 to 70 days. The possible mechanism of the effects seen and their bearing on maximum permissible exposure calculations are briefly discussed. (auth)

TRACER APPLICATIONS

4056 UCLA-331

Atomic Energy Project, Univ. of Calif., Los Angeles
THE EFFECT OF CERTAIN ENVIRONMENTAL FACTORS ON MINERAL UPTAKE BY BEAN PLANTS. II. CALCIUM AND STRONTIUM UPTAKE. Arthur H. Lange, William L. Ehrler, and Karl C. Hamner. Atomic Energy Project, Univ. of Calif., Los Angeles and Univ. of California, Los Angeles. Mar. 31, 1955. 28p. Contract AT-04-1-Gen-12.

The effect of short-term variations in certain environ-

mental factors on calcium and strontium uptake by bean plants from nutrient solutions were studied under controlled conditions using Ca^{45} and Sr^{89} tracer isotopes. Calcium uptake was reduced at low pH levels and reached a maximum uptake between the range of pH 5 and pH 6. At higher pH levels, calcium uptake rapidly decreased to pH 8.5 at which point damage to the foliage was apparent. Calcium uptake increased as the calcium and phosphate levels of the nutrient solutions increased; the concentrations of other ions showed no influence on calcium uptake. Lowering of root temperature from 27 to 17°C increased the uptake of both calcium and strontium. At 27°C root temperature, lowering the light intensity from 1,000 to 450 foot-candles reduced calcium uptake to one-third and strontium uptake to nearly one-seventh of the amounts taken up at 1,000 f.c. light intensity. This effect of lowered light intensity on reducing calcium and strontium uptake was not as severe at 17°C root temperature indicating an interaction between light intensity and root temperature. Lack of forced aeration of the nutrient solution for as little as 36 hours resulted in approximately a 45 per cent reduction in calcium uptake which was nearly the same for plants whose roots were killed by boiling water at the beginning of the treatment period but were supplied continuous forced aeration. (auth)

CHEMISTRY

4057 AD-35353

West Virginia Univ.

RESEARCH AND DEVELOPMENT ON HIGH-FREQUENCY FIELDS FOR CHEMICAL ANALYSIS. TECHNICAL REPORT NO. 3 [FOR PERIOD] SEPTEMBER 16, 1953-JUNE 15, 1954. A HIGH AND LOW FREQUENCY CONDUCTOMETRIC STUDY OF SOME REACTIONS OF BORON TRIFLUORIDE ETHERATE. John A. Gibson, Jr., James L. Hall, Harold O. Phillips, and Paul R. Wilkinson. 32p. Contract DA-36-061-ORD-383.

The reactions of $\text{BF}_3 \cdot \text{O}(\text{C}_2\text{H}_5)_2$ with other substances in various solvents are discussed. A conductometric procedure for the analysis of the etherate is presented. The possible use of the etherate as an analytical reagent for the determination of water and other compounds was investigated. (C.W.H.)

4058 AD-35942

Holston Defense Corp.

MAGNESIUM NITRATE PILOT PLANT FOR CONCENTRATION OF NITRIC ACID. SUMMARY REPORT [FOR] JANUARY 2, 1951-JANUARY 19, 1953. R. A. Williams. Jan. 26, 1953. 110p.

4059 CCC-1024-TR-93

Pennsylvania Coll. for Women

A PHASE RULE STUDY OF THE SYSTEM CALCIUM CHLORIDE-LITHIUM CHLORIDE-POTASSIUM CHLORIDE. E. K. Wallace, M. B. Cannon, N. Norris, A. Plottel, and B. Senior. Feb. 8, 1955. 14p. [For Callery Chemical Co. Contract NOa(s)-1024-c].

The freezing points of various compositions of the CaCl_2 - LiCl - KCl system were studied. Two probable ternary eutectic points for the system are introduced. (C.W.H.)

4060 MLM-973

Mound Lab.

THE SOLUBILITY OF POLONIUM NITRATE IN NITRIC

ACID SOLUTIONS. (INFORMATION REPORT). E. Orban. July 27, 1954. 26p. Contract AT-33-1-GEN-53.

The solubility of polonium nitrate has been determined in nitric acid solutions at acid concentrations from 0.1 to about 8 N and at temperatures of 25, 35, and 45°C. The solubility ranges from 1.9×10^{-5} moles per liter at the lowest temperature and acid concentration to 4.6×10^{-3} moles per liter at the highest temperature and acid concentration. The increase in solubility was found to be a linear function of the acid concentration which changed to a second linear function at a concentration above 1.5 N nitric acid. (auth)

4061 NACA-TN-2838

California Univ., Berkeley

CALORIMETRIC DETERMINATION OF CONSTANT-PRESSURE SPECIFIC HEATS OF CARBON DIOXIDE AT ELEVATED PRESSURES AND TEMPERATURES. Virgil E. Schrock. [Jan. 31, 1952]. 47p.

The constant-pressure specific heat of carbon dioxide has been measured over the range of pressures and temperatures from ambient conditions to 1000 pounds per square inch gage and 1000°F using a steady-flow calorimeter operating on an open cycle. The values at elevated pressures are in reasonable agreement with those derived from the zero-pressure spectroscopic values and the application of the Beattie-Bridgeman equation of state. (auth)

4062 NP-5591

Pepperdine Coll.

RESEARCH IN THE FUNDAMENTAL CHEMISTRY OF THE BORON HYDRIDES. ANNUAL SUMMARY REPORT NO. 1. THE BORON BASES. George W. Campbell, Jr. Sept. 1, 1953. 13p. Contract DA-04-495-ORD-377.

The preparation process for the boron base $\text{Na}_2\text{HB}(\text{CH}_3)_2$ has been modified such that larger samples (2 to 3 mmoles) can now be prepared without appreciable disproportionation of the reactant $(\text{CH}_3)_4\text{B}_2\text{H}_2$, by carrying this substance into the liquid $\text{Na}-\text{NH}_3$ solution on a stream of N_2 . The separation of the product from excess Na metal, however, is not readily accomplished since the solvents studied either are not effective, or they react with $\text{Na}_2\text{HN}(\text{CH}_3)_2$. On a small scale, however, CH_3NH_2 can be used to good advantage, although a solvate is formed which cannot be decomposed without aminolysis. The preparation of the pentamethyl diborohydride salt $\text{Na}_2\text{HB}_2(\text{CH}_3)_5$ by the reaction of $(\text{CH}_3)_4\text{B}_2\text{H}_2$ and $\text{B}(\text{CH}_3)_3$ with a $\text{Na}-\text{NH}_3$ solution, followed by CH_3NH_2 extraction has proven quite satisfactory on a small scale (0.5 mmoles.) It has been further observed that $\text{Na}_2\text{HB}_2(\text{CH}_3)_5$ reacts with SiH_3Cl to produce an equivalent quantity of SiH_4 , in much the same manner as when $\text{Na}_2\text{HB}(\text{CH}_3)_2$ is treated with SiH_3Cl . A study of the reaction of $(\text{CH}_3)_4\text{B}_2\text{H}_2$ with a $\text{Na}-\text{NH}_3$ solution, when the former is in excess, has given some evidence for the existence of NH_3 -soluble $\text{Na}_2\text{H}_2\text{B}_2(\text{CH}_3)_4$. It is believed that when the NH_3 is removed and the product is warmed, disproportionation occurs, producing $\text{NaH}_2\text{B}(\text{CH}_3)_2$ and polymeric $\text{NaB}(\text{CH}_3)_2$. (auth)

4063 NP-5605

Technical Information Div., Library of Congress
BORON, BORON HYDRIDES, AND RELATED SUBSTANCES: A BIBLIOGRAPHY. PART II. Thomas C. Goodwin, Jr. and Mary E. Schroder. Apr. 1955. 104p.

Results of a literature search of material published from 1950 through 1952 are presented. 210 references. (C.W.H.)

4064 AERE-Lib/Trans-509

THE THEORY OF SLOW ELECTRODE REACTIONS IN POLAROGRAPHY AND THE POLAROGRAPHIC BEHAVIOUR OF A SYSTEM IN WHICH THE DEPOLARISER IS FORMED FROM AN ELECTRO-INACTIVE SUBSTANCE BY MEANS OF A RAPID CHEMICAL REACTION. J. Koutecky. Translated by F. Hudswell from Collection Czechoslov. Chem. Commun. **18**, 597-610(1953) 15p.

An analysis is presented of polarographic currents in a system in which the depolarizer is formed from an electro-inactive substance by means of a very rapid pseudo-unimolecular chemical reaction. It is shown that the theory can be formulated as a special case of those electrode reactions whose velocity is finite. The instantaneous and average current for the two cases has been calculated. The results of the theory are compared with those of earlier theories. It is found that the same expressions are obtained, including numerical factors, with the theory for average current as with the approximate theory. (auth)

4065

ON THE HYDROLYSIS OF LITHIUM BOROHYDRIDE. V. I. Mikheeva and E. M. Fedneva (Kurnakov Inst. of General and Inorganic Chemistry). Doklady Akad. Nauk S.S.S.R. **101**, 99-101(1955) Mar. 1. (In Russian)

4066

HISTOCHEMICAL AND CHEMICAL EVIDENCE FOR MORE THAN ONE ALKALINE PHOSPHOMONOESTERASE. Mario H. Burgos, Helen Wendler Deane, and Manfred L. Karnovsky (Harvard Medical School, Boston, Mass.). J. Histochem. Cytochem. **3**, 103-21(1955) Mar.

4067

A THEORETICAL STUDY OF THE COLOURED ALKALI OXIDES. Barbro Grabe. Arkiv Fysik **9**, No. 3, 229-43 (1955). (In English)

The dark color of $Rb_4(O_2)_3$ is explained by describing the electron distribution in terms of semi-localized orbitals. The Rb atom and the nearest three O atoms are considered, and it is assumed that the valence electron of Rb can be assigned to a molecular orbital of this group. The parameters of the orbital are determined by minimizing the energy of the electron. Two electronic states are obtained, having an energy difference between them which corresponds to a wavelength in the visible part of the spectrum. Thus a transition between those states can explain the color of the crystal. A valence bond method is also discussed. (auth)

4068

A QUANTUM THEORETICAL STUDY OF THE COVALENT BORON-BORON BONDS IN CRYSTALS OF SOME METAL BORIDES. Stig Flodmark. Arkiv Fysik **9**, No. 3, 357-76 (1955). (In English)

The electronic distribution around the boron atoms in metal borides with stable space lattices has been theoretically determined and interpreted as covalent bonds in the directions of adjacent boron atoms. Two methods have been used. In the first method the wave function is assumed to have an extreme value, when the valence electrons of a given boron atom are located in the bond directions. Hydrogen-like atomic orbitals (AO's) have been used. There is reason to believe that the metal atoms are ionized, with the result that every boron atom has between three and four valence electrons instead of three as usual. As it is impossible in this case to compose an antisymmetric wave function for the

electrons of one atom, the electron density has also been determined by the condition of maximum values in the bond directions. Both methods gave the result that the excited 3d orbitals play an important role in describing the bonds, as they make it possible to arrange the electrons according to the crystalline symmetry. However, the approximations made probably give an overestimation of this effect. By using the method of maximum density the excited orbitals were found to dominate almost completely. In spite of this, variation of the effective charge parameter of the d orbitals gave interesting results. (auth)

4069

RADIOCHEMICAL STUDIES ON ULTRA-MICRO QUANTITIES OF ORGANOMETALLIC COMPOUNDS. II. ON THE COMPOSITION OF POLONIUM DITHIZONATE. Tomitaro Ishimori (Kyushu Univ., Fukuoka, Japan). Bull. Chem. Soc. Japan **27**, 520-2(1954) Nov.

The chemical composition of polonium dithizonate (formed in a solution acidified by nitric acid) is determined by the method presented in Bull. Chem. Soc. Japan **27**, 139(1954). It is estimated that two anions of dithizone are bound to one atom of polonium in polonium dithizonate. (auth)

4070

THE DIFFUSION COEFFICIENT OF CALCIUM CHLORIDE IN DILUTE AND MODERATELY DILUTE SOLUTIONS AT 25°. Herbert S. Harned and Herman W. Parker (Yale Univ., New Haven, Conn.). J. Am. Chem. Soc. **77**, 265-6(1955) Jan. 20.

The diffusion coefficient of $CaCl_2$ has been determined by the conductometric method at concentrations between 0.001 and 0.02M. (auth)

4071

THE ACTIVITY COEFFICIENT OF HYDROCHLORIC ACID IN CONCENTRATED AQUEOUS HIGHER VALENCE TYPE CHLORIDE SOLUTIONS AT 25°. II. THE SYSTEM HYDROCHLORIC ACID-STRONTIUM CHLORIDE. Herbert S. Harned and Robert Gary (Yale Univ., New Haven, Conn.). J. Am. Chem. Soc. **77**, 1994-5(1955) Apr. 5.

The activity coefficient of hydrochloric acid in strontium chloride solutions has been determined at 1, 3, and 5 ionic strengths. The rule of linear variation of the logarithm of the activity coefficient of the acid at these total constant ionic strengths is verified. Following a procedure which employs the Gibbs-Duhem equation and cross differentiation relations, the thermodynamics of the system has been developed. (auth)

4072

VELOCITY ULTRACENTRIFUGATION AND DIFFUSION OF SILICOTUNGSTIC ACID. Melvin C. Baker, Philip A. Lyons, and S. J. Singer (Yale Univ., New Haven, Conn.). J. Am. Chem. Soc. **77**, 2011-12(1955) Apr. 5.

The sedimentation coefficients and differential diffusion coefficients have been experimentally determined for silicotungstic acid, $H_4SiW_{12}O_4 \times H_2O$. From these constants and by means of the Svedberg equation, the calculated molecular weight of the anion $SiW_{12}O_4^{4-}$ is 2.91×10^3 . This is in excellent agreement with the formula weight 2875.1. (C.W.H.)

4073

THE 30° ISOTHERM OF THE TERNARY SYSTEM: WATER-LITHIUM OXIDE-BORON OXIDE. Antoine-Pierre Rollet and Roger Bouaziz. Compt. rend. **240**, 1227-9(1955) Mar. 14. (In French)

ANALYTICAL PROCEDURES

4074 ANL-5410

Argonne National Lab.

MANUAL OF SPECIAL MATERIALS ANALYTICAL LABORATORY PROCEDURES. James H. Patterson, H. B. Evans, C. M. Stevens, A. L. Harkness, J. Sedlet, J. P. Hughes, J. K. Brody, V. R. Wiederkehr, and R. J. Ferretti. Mar. 1955. 91p. Contract W-31-109-Eng-38.

Procedures are outlined for the following: titrimetric determination of U with the Jones reductor; titrimetric determination of U with the Pb reductor; gravimetric peroxide method for U determination; gravimetric determination of U in essentially pure oxides; spectrophotometric determinations of U with thiocyanate and K ferrocyanide; fluorophotometric determination of U; titrimetric and radiometric determinations of Pu; spectrophotometric determination of Zr; gravimetric determination of Zr in Nb-U ternary alloys; gravimetric determination of Zr with p-chloromandelic acid; spectrophotometric determination of Nb in U ternary alloys; iodometric determination of Sn in Nb-U ternary alloys; the determination of Si in U-Si alloys; spectrophotometric determination of Fe in presence of U with 1,10-phenanthroline; spectrochemical determination of heavy elements in UO_2 ; isotopic determination by the mass spectrometer; balance testing procedure; and analytical weight calibration. (L.M.T.)

4075 KAPL-1300

Knolls Atomic Power Lab.

THE CONTINUOUS DETECTION OF HYDROGEN OR HYDROGENOUS MATERIALS IN GASES. L. P. Pepkowitz. Apr. 14, 1955. 13p. Contract W-31-109-Eng-52.

An instrument which is based on the dewpoint principle is described for the continuous detection of hydrogen or hydrogenous material in gases. The sensitivity is claimed to be 0.001 volume percent. (C.W.H.)

4076 UR-390

Atomic Energy Project, Univ. of Rochester

THE DETERMINATION OF FLUORIDE IN URINE.

Frank A. Smith and Dwight E. Gardner. Mar. 22, 1955. 21p. Contract W-7401-eng-49.

A procedure is described for the quantitative determination of fluoride in urine. The fluoride is separated from a perchloric acid solution of ashed urine by steam distillation of volatile fluorosilicic acid; fluoride in the distillate is titrated with thorium nitrate using alizarin red S as indicator. A statistical evaluation of the precision and accuracy of the method is presented. (auth)

4077 AERE-Lib/Trans-493

SYSTEMATIC INVESTIGATIONS INTO THE APPLICABILITY OF DIETHYLDITHIOCARBAMATES IN ANALYSIS. II. FORMATION OF METAL-DIETHYLDITHIOCARBAMINATES AND THEIR EXTRACTABILITY IN DEPENDENCE ON THE pH VALUE OF THE SOLUTION. Helmut Bode. Translated by A. H. Gillieson from *Z. anal. Chem.* 143, 182-95(1954). 13p.

The behavior of DDTC with metal-salt solutions and the ease of extraction of individual metal-DDTC-compounds at various pH-values as well as in the presence of Complexone and KCN has been investigated. The absorption spectra of these compounds has been recorded. In addition the molar ratio in which metal and DDTC unite in the compound, has been determined. The experimental results collected in tabular form bring forward a series of new possibilities for the analytical application of DDTC. (auth)

4078

COMPLEXOMETRIC TITRATION OF ALUMINUM. Erkki Wänninen and Anders Ringbom (Abo Akademi, Finland). *Anal. Chim. Acta* 12, 308-18(1955) Apr. (In English)

A new and simple method for the quantitative determination of thallium based on the oxidation of Tl(I) to Tl(III) by selenious acid has been described. The precipitated selenium is weighed directly. Furthermore, the thallic hydroxide obtained by the addition of excess alkali to the filtrate is dissolved in HCl and determined iodometrically. The excess selenious acid in the filtrate is also estimated iodometrically or by gravimetric method after reduction to metallic selenium. Under the specified operative conditions the results are reproducible and accurate within the limits of experimental error. (auth)

4079

ESTIMATION OF THORIUM BY ORGANIC REAGENTS. RECOVERY FROM WORN-OUT GAS MANTLES AND TUNGSTEN FILAMENTS BY 2:4-DICHLOROPHENOXY-ACETIC ACID. Sachindra Kumar Datta and Gurupada Banerjee (Darjeeling Government Coll., India). *Anal. Chim. Acta* 12, 323-8(1955) Apr. (In English)

2:4-Di-chlorophenoxyacetic acid can be used as a reagent for the determination and extraction of thorium present in industrial wastes like worn-out gas mantles and tungsten filaments. At a pH of 2.8 to 3 thorium gives a voluminous precipitate with 2:4-D, which filters, washes, and ignites readily. The voluminous nature of the precipitate is advantageous in the detection and determination of the very small quantity of thorium present in the filaments. The % recovery of thorium from gas mantles and tungsten filaments is 89.5 and 0.8 respectively. The process can only be utilized for the extraction of thorium from the filaments if a huge quantity of such materials can be procured at a time. (auth)

4080

SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM IN NIOBIUM-BEARING STEELS. James L. Kassner, Asdrubal Garcia-Porrata, and E. L. Grove (Univ. of Alabama, University). *Anal. Chem.* 27, 492-4(1955) Apr.

A simple procedure for the colorimetric determination of niobium in niobium-bearing steels has been developed which involves only two separations: a perchloric acid hydrolytic precipitation and a chloroform extraction of the metal derivative of 8-quinolinol. The great bulk of the steel components is removed as soluble perchlorates in the first separation. Elements that may contaminate the niobic acid precipitate do not interfere because they do not react with 8-quinolinol, their oxinates (quinolinates) are insoluble in chloroform, or they are not extracted by chloroform from the ammoniacal citrate solution. The method makes use of the yellow color of chloroform solutions of niobium oxinate which shows maximum absorbance at 385 m μ . The method has been applied successfully to a niobium-bearing steel standard and to a series of composite steels. It involves a considerable saving in time and fewer mechanical operations without a sacrifice in accuracy. (auth)

4081

PHOTOMETRIC TITRATION ASSEMBLY FOR BECKMAN MODEL DU SPECTROPHOTOMETER. Donn W. Klingman, Donald T. Hooker, and Charles V. Banks (Iowa State Coll., Ames). *Anal. Chem.* 27, 572(1955) Apr.

4082

WATER ANALYSIS. S. K. Love and L. L. Thatcher (U. S.

Geological Survey, Washington, D. C.). Anal. Chem. **27**, 680-90(1955) Apr.

A review of literature published on analytical procedures applied to water for the period 1952 to 1954 is presented. 248 references. (C.W.H.)

4083

MICROCHEMICAL PREPARATION OF RADIOACTIVE BERYLLIUM 7. Robert Mellet, Pascaline Daudel, and Roland Muxart (Institut du Radium, Paris). Bull. soc. chim. France, No. **4**, 560-3(1955) Apr. (In French)

4084

DETERMINATION OF HAFNIUM AND ZIRCONIUM BY OPTICAL SPECTRAL ANALYSIS. E. V. Gusyatskaya and A. K. Rusanov (All-Union Inst. Of Mineral Resources, Moscow). Zhur. Anal. Khim. **10**, 75-85(1955) Mar.-Apr. (In Russian)

4085

THE ANALYSIS OF BINARY GAS MIXTURES BY A SONIC METHOD. E. W. Pulsford (Atomic Energy Research Establishment, Harwell, Berks, England). J. Brit. Inst. Radio Engrs. **15**, 117-28(1955) Feb.

The operation of the instrument described is based on the variation of the velocity of sound in a mixture of two gases, with the proportions of the mixture. The velocity of sound is determined at a fixed temperature by measuring the resonance frequency of a double Helmholtz resonator containing the mixture. The source of the sound is a diaphragm driven electromagnetically from a variable-frequency oscillator; a similar transducer followed by an amplifier and rectifier form the resonance detector. The method of continuous recording of the mixture proportions, is also described. In this, the gas mixture flows through the resonator, and a simple servomechanism is used to maintain the condition of resonance and to operate the recorder. (auth)

4086

NEW SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM AND COBALT WITH DISODIUM ETHYLENEDIAMINETETRAACETATE. Hidehiro Goto and Jun-ichi Kobayashi (Research Inst. for Iron, Steel and Other Metal, Japan). Science Repts. Tohoku Univ. Ser. A **6**, 551-6(1954) Dec.

A spectrophotometric method for the determination of Co^{2+} and Cr^{3+} based on the absorbancies of the metal complexes formed with EDTA is reported. The absorbancies were measured at 558m μ in 0.5N HAc. Chief interfering ions are Fe^{3+} , Ni^{2+} , and Cu^{2+} . (C.W.H.)

4087

A MECHANICAL CALCULATOR FOR BACKGROUND CORRECTION IN SPECTROGRAPHIC ANALYSIS. R. M. McKenzie and A. W. Palm (C.S.I.R.O., Adelaide, Australia). Australian J. Appl. Sci. **6**, 38-40(1955) Mar.

The construction and use of a mechanical calculator for background correction in spectrographic analysis is described. The calculator consists of two concentric disks, with log intensity scales engraved in such a way that peripheral distances from the zero are proportional to natural numbers. By rotating the inner disk until the log intensity of the background on the inner scale coincides with the log intensity of the line plus background on the outer scale, the zero of the inner scale is brought opposite the corrected log line intensity. Provision is made for marking density scales on the calculator, so that density values may be set directly, without first converting to log intensities. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

4088 AD-37801

North Carolina State Coll.
THE HEXAGONAL STRUCTURE IN THIN FILMS OF NICKEL (thesis). Charles Glenn Deese. 1954. 42p.

On the basis of a survey of literature on hexagonal nickel and experimental results obtained from thin films of nickel evaporated in a high vacuum, it is concluded that current ideas concerning the existence of a close-packed hexagonal modification of nickel should be revised. Thus some hexagonal regions may exist in nickel films of less than approximately 500 Å thickness, but no complete hexagonal structure exists. In all other instances, reported hexagonal structures should be interpreted as resulting from interstitial nickel compounds. (auth)

4089

ON LITHIUM DIBORATE. Antoine-Pierre Rollet and Roger Bouaziz. Compt. rend. **240**, 1104-5(1955) Mar. 7. (In French)

Hydrated lithium diborate was crystallized from aqueous solution. Fine crystals were obtained that were slightly soluble in H_2O . The formula for the crystal was found to be $2\text{B}_2\text{O}_3 \cdot \text{Li}_2\text{O} \cdot 4\text{H}_2\text{O}$. (tr-auth)

DEUTERIUM AND DEUTERIUM COMPOUNDS

4090

RADIATION INDUCED EQUILIBRIUM OF HYDROGEN-DEUTERIUM MIXTURES. S. O. Thompson and O. A. Schaeffer (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys. **23**, 759-60(1955) Apr.

Radiation equilibrated (Po^{210} α and 2-Mev Van de Graaff electrons) mixtures of H_2 and D_2 were compared directly to catalytically (Ni) equilibrated mixtures. The radiation induced equilibrium constant agreed with the catalytic constant within the experimental precision of 1%. (C.W.H.)

FLUORINE AND FLUORINE COMPOUNDS

4091 NP-5595

Iowa State Coll.
ORGANO-METALLIC AND ORGANO-METALLOIDAL HIGH TEMPERATURE LUBRICANTS AND RELATED MATERIALS. QUARTERLY PROGRESS REPORT FOR JAN. 1, 1955 TO MARCH 31, 1955. 17p. Contract AF 33(616)-94.

The preparation and several chemical reactions of *o*-fluorophenyllithium are described. The syntheses of several tetrasubstituted phenylsilanes are included. Preliminary studies are presented on cyclic compounds in which the metal and the metalloid are part of the ring. (C.W.H.)

4092

THE INFRARED SPECTRUM OF SULFUR FLUORIDE. José R. Barceló and Clara Otero (Instituto de Optica Daza de Valdes, Madrid, Spain). Anales real soc. españ. fis. y quim. (Madrid) Ser. B **51**, 223-6(1955) Mar. (In Spanish)

The infrared spectrum of S_2F_2 is studied. The substance was in the gas state and the spectrum was run from 2000 to 400°K. Three fundamental frequencies were assigned. If they are correct, the molecular model may be the cis-form of C_{2v} symmetry or the non-planar form of C_2 symmetry. The trans-form of C_{2h} symmetry is excluded. (auth)

GRAPHITE

4093 AERE-Lib/Trans-520

THE PHYSICAL CHEMISTRY OF THE MODERN PREPARATION AND USE OF GRAPHITE. E. Ryschkewitsch. Translated by F. Hudswell from *Z. Elektrochem.* **42**, 687(1936) 1p.

LABORATORIES AND EQUIPMENT

4094 AD-35356

West Virginia Univ.

RESEARCH AND DEVELOPMENT ON HIGH-FREQUENCY FIELDS FOR CHEMICAL ANALYSIS. LARGE VOLUME CELL ADAPTED FOR SIMULTANEOUS HIGH-FREQUENCY, CONVENTIONAL CONDUCTANCE, AND POTENTIOMETRIC TITRATIONS. TECHNICAL REPORT NO. 1 [COVERING THE PERIOD] SEPTEMBER 16, 1953 [TO] MARCH 15, 1954. Paul R. Wilkinson, John A. Gibson, Jr., and James L. Hall. 4p. Contract DA-36-061-ORD-383.

4095

PERFORMANCE OF HOT WIRE THERMAL DIFFUSION COLUMNS. R. C. Srivastava (Univ. of Lucknow, India).

Proc. Phys. Soc. (London) **A68**, 294-6(1955) Apr.

Furry and Jones' theory of the thermal diffusion column for the extreme cylindrical case has been extended to take into account the temperature variation of the thermal diffusion constant α with temperature in the usual form $\alpha = A - B'/T$. The expressions so obtained for the column constant H are shown to agree closely with the experimental data of Simon on argon. (auth)

4096

AN ISOTHERMAL BATH FOR USE IN THE TEMPERATURE RANGE 200-500°C. W. H. Bridges, J. V. Cathcart, and G. P. Smith (Oak Ridge National Lab., Tenn.). *J. Sci. Instr.* **32**, 139-40(1955) Apr.

A constant-temperature bath having excellent control and stability characteristics has been constructed. A molten 50-50 wt. % mixture of sodium nitrate and sodium nitrite, vigorously stirred, was used as the bath liquid. An electronically balanced Wheatstone bridge, operated in conjunction with a platinum resistance thermometer, controlled the bath temperature; a second resistance thermometer served to monitor the temperature. Temperature fluctuations of $\pm 0.025^\circ\text{C}$ at 400°C were observed over a period of 500 hr, but control to $\pm 0.01^\circ\text{C}$ could be attained for shorter periods of time. (auth)

4097

NEW TOWER PACKING SHOWS HIGH THROUGHPUT.

Chem. Eng. **62**, No. 5, 126-8(1955) May.

The construction and performance of a new distillation tower packing are described. The packing consists of sheets of Al mesh which are formed into a continuous cellular structure. Typical pressure-drop and HETP data are included. (C.W.H.)

4098

THE HANDLING OF RADIOACTIVE MATERIALS. I. K. W. Bagnall and W. T. Spragg (Atomic Energy Research Establishment, Harwell, Berks, England). *Atomics* **6**, 71-8(1955) Mar.

Emphasis is placed on the design of a laboratory for the handling of radioactive materials. The construction of fume chambers and glove boxes is described in detail. General rules for working conditions in the laboratory are given. (C.W.H.)

MOLECULAR STRUCTURE

4099

AN LCAO MO STUDY OF THE STRUCTURE OF CHLOROPHYLL PROTOTYPES. Sheldon Matlow (Brookhaven National Lab., Upton, N. Y.). *J. Chem. Phys.* **23**, 673-80 (1955) Apr.

By means of Wheland's method of treating systems with hetero-atoms three possible isomers of porphyrin and five of dihydroporphyrin are studied from the viewpoint of the energies of the ground states and the transition energies to the lowest lying excited states. In the case of porphyrin it is found that, within the limits of accuracy of the method used, two of the structures, PA (porphyrin-adjacently bonded hydrogens) and PO (porphyrin-oppositely bonded hydrogens) have identical ground state energies. In the case of dihydroporphyrin the DHP-AI (DHP-A—dihydroporphyrin-adjacently bonded hydrogens) isomer is most stable and the DHP-AII and DHP-OII (DHP-O—dihydroporphyrin-oppositely bonded hydrogens) isomers are more energetic by 1.06 and 1.20 kcal/mole, respectively. With respect to the transition energies and the resulting spectra it is possible that the peaks in the spectrum of porphyrin are not due mainly to vibrational fine structure of a single electronic transition, as is proposed by Rabinowitch, but rather are the combination of the electronic spectra of the PA and PO isomers. The dihydroporphyrin spectral analysis, however, indicates that several of the peaks are probably vibrational fine structure of a single electronic transition. The calculated bond orders are given for the various structures discussed. (auth)

RADIATION CHEMISTRY

4100 BNL-2275

Brookhaven National Lab.

GAMMA RAY INITIATED POLYMERIZATION OF N-VINYLPYRROLIDONE. D. Ballantine, A. Glines, and B. Manowitz. [1955?] 15p.

Since polyvinylpyrrolidone is used as a blood plasma expander, the polymerization of *N*-vinylpyrrolidone by γ rays has been investigated. The rate of polymerization and average molecular weight were determined as function of temperature, γ ray intensity, monomer concentration, and solvent composition. Some fractionations were made on the radiation produced polymer, and the effect of radiation on polymer molecular weight was examined. It appears feasible to use γ irradiation to produce polyvinylpyrrolidone of desirable average molecular weight for a plasma expander and of narrower molecular weight distribution than that of Plasdene, a commercial polyvinylpyrrolidone. (M.P.G.)

4101 ORO-137

Arkansas Univ. Coll. of Arts and Sciences

CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATION. ANNUAL PROGRESS REPORT. R. R. Edwards. Jan. 1, 1955. 94p. Contract AT(40-1)-277.

Several new studies of radioactive decay schemes have been undertaken, along with an experimental examination of the inner bremsstrahlung spectrum accompanying electron capture. Tracer studies of isotopic exchange, reaction mechanisms, and isotope effects have continued. Investigations of the dilute solution chemistry of iodine and of the valence states of fission products have been brought to a close. Theoretical studies of molecular excitation accom-

panying beta decay have continued, and some results of calculations on the H_2-HHe^+ system are reported. (auth)

RADIATION EFFECTS

4102

REACTOR AND GAMMA-RAY INDUCED COLORING IN CRYSTALLINE QUARTZ AND CORNING FUSED SILICA.

Paul W. Levy (Brookhaven National Lab., Upton, N. Y.).

J. Chem. Phys. **23**, 764-5(1955) Apr.

The absorption bands induced in corning fused silica and crystalline quartz by gamma and reactor irradiation have been studied. Differences in observed colorations may have been due to impurities, or lack of impurities in the samples. (C.W.H.)

4103

IMPURITY INDUCED COLOR CENTERS IN FUSED SILICA.

Alvin J. Cohen (Mellon Inst., Pittsburgh). *J. Chem. Phys.*

23, 765-6(1955) Apr.

The absorption bands induced in various samples of silica by X irradiation and heat treatment were studied. Results indicated that impurities present in some silicas were responsible for the induced color centers. (C.W.H.)

SEPARATION PROCEDURES

4104 WAL-120/73

Armour Research Foundation

METHODS OF SEPARATION OF TOTAL RARE EARTHS IN LOW-ALLOY CONSTRUCTIONAL STEELS: BIBLIOGRAPHY. Ann Wennerberg. Nov. 10, 1954. 166p. Contract DAL-11-022-ORD-(P)-6.

A comprehensive survey was made of the technical literature from 1940 to the present pertaining to the rare earths. Selections for the bibliography were limited to references on chemical methods of separation, fractionation, and determination. Studies of chemical and physical properties of rare earths and rare-earth compounds were also included wherever it appeared that they might suggest a basis for new or improved analytical schemes. (auth)

4105

CHROMATOGRAPHIC SEPARATION OF BARIUM-STRONTIUM ON CELLULOSE. II. CHROMATOGRAPHY ON CELLULOSE POWDER.

J. Fouarge (Univ. of Liège, Belgium). *Anal. Chim. Acta* **12**, 342-50(1955) Apr. (In French)

The systematic investigation of a good Ba^{+2} - Sr^{+2} separation using a cellulose powder column has given us the choice of two eluants: (a) methanol 1.2N in HCl (gazeux) + water (v/v:100/5) and (b) methanol-ether-HCl 12N (v/v:75-25-5). The second one gave excellent separations, both in quantities of the order of 200 mg and in tracer amounts: $Sr \leq 0.001 \mu g$ - $Ba \leq 0.8 \mu g$. The eluting power of the solvent after the complete elution of Sr^{+2} (suppression of ether) is increased, the time and volume needed for the Ba^{+2} elution is considerably reduced. (auth)

4106

EFFECT OF CONCENTRATION AND SORPTION UPON MIGRATION OF CATIONS IN PAPER ELECTRO-CHROMATOGRAPHY.

Takuya R. Sato, William P. Norris, and Harold H. Strain (Argonne National Lab., Lemont, Ill.). *Anal. Chem.* **27**, 521-5(1955) Apr.

This investigation was designed to test the effect of concentration and sorption of cations upon their electrical migration through moist paper. Under the conditions em-

ployed in electrochromatography and with zones of ions such as lead and bismuth, that are readily sorbed by the paper, the rate of the electrical migration is least at the lowest concentration and increases with concentration, approaching a limit as the concentration of the ions in the migrating zones approaches the ionic concentration of the background electrolytic solution in the paper. In chromatographic tests based upon flow of the electrolytic solution through the paper, the migration of the zones of sorbed ions also increases with concentration. Consequently, the proportion of the ions sorbed by the paper must decrease with increasing concentration; conversely, the proportion of the ions remaining nonsorbed in the solution must increase with the increasing concentration. As the nonsorbed fraction of the ions should undergo faster electrical migration than the sorbed fraction, the electrical migration of all the ions should be proportional to the fraction not sorbed and should increase with concentration. For the precise description of migration rates, migration sequences, and separability, the concentration and the sorbability of the migrating ions should be specified. The effect of concentration upon the electrochromatographic separation of radium from its principal radioactive daughters and from barium has been determined. (auth)

SYNTHESES

4107 AD-29764

Chicago Development Corp.

RESEARCH ON A NEW CLASS OF INORGANIC COMPOUNDS CAPABLE OF POLYMERIZING INTO USEFUL STRUCTURAL MATERIALS. FINAL REPORT [FOR] MARCH 1, 1953 TO FEBRUARY 28, 1954. Irwin Hornstein. 21p. Contract AF18(600)-656.

Progress is reported in studies directed toward the production of substantially inorganic polymers. A series of reactions have been developed for converting the reaction products of a polyvalent halide and a Grignard reagent into a new type of thermo-plastic material. Polymers consisting essentially of iron, vanadium, and oxygen with small amounts of carbon, hydrogen, and nitrogen have been prepared which can be heated to 700°C without loss of thermal plasticity. Molded parts retain their dimensional stability and detail without distortion even at this temperature. These molded products also maintain their integrity when heated in air for short periods to 500°C. When heated for longer periods at this temperature, surface oxidation appears to take place, but again the molded parts retain their shape, size, and surface details. This material can be leached with water without any deleterious effects. A series of reaction mechanisms has been postulated to explain the nature and formation of these new iron-vanadium-oxygen thermo-plastic materials. In addition, thermo-plastic materials of a similar nature have been prepared in which vanadium, iron, titanium, silicon, and boron were used. (auth)

4108 NP-5598

Southwest Research Inst.

POLYNUCLEAR AROMATIC COMPOUNDS FOR HIGH TEMPERATURE LUBRICANTS. QUARTERLY REPORT NO. 1 [FOR] NOVEMBER 20, 1954-MARCH 1, 1955. TECHNICAL REPORT NO. 10. Charles F. Raley, Jr. 19p. Contract AF33(616)-276.

It was found possible to inhibit crystallization of chlorophenyl phosphates by preparing physical-chemical

mixtures, starting with mixed isomeric phenols. Other properties are not adversely affected. Two pyrophosphates were prepared and proved to have disappointing thermal stability although possessing good viscosity characteristics. The compound bis(o-chlorophenyl)m-trifluoromethylphenyl phosphate possessed the relatively low pour point of -30°F although with considerable lowering of the boiling point (378°C , 712°F). (auth)

4109

RADIOSYNTHESIS OF UREA. Jean Loiseleur and Michelle Petit. *Compt. rend.* 240, 1026-7(1955) Feb. 28. (In French)

A new method of synthesizing urea is described by the action of x rays on a methanol solution of methyl chloride, ammonia, and m-phenylenediamine. (tr-auth)

TRANSURANIC ELEMENTS AND COMPOUNDS

4110 LA-1864

Los Alamos Scientific Lab.

THE DETERMINATION OF FREE ACID IN PLUTONIUM SOLUTIONS. Maynard E. Smith. Jan. 1955. 26p. Contract W-7405-eng-36.

A method is described for the determination of free acid in plutonium solutions having an excess acidity greater than 0.2 N. The hydrolytic interference of plutonium(IV) is prevented by precipitation with potassium iodate and subsequent removal by filtration. The filtrate is then titrated with a standard base using a potentiometric end point. If plutonium(VI) is known to be absent, phenolphthalein may be used as an indicator. The standard deviation for 49 determinations was 0.9%. A method is suggested for determining the amount of plutonium(VI) in a solution by the potentiometric titration of the iodate filtrate with a standard base. (auth)

4111

ZEEMAN EFFECTS IN THE SPECTRUM OF PLUTONIUM. P. M. Griffin and J. R. McNally, Jr. (Oak Ridge National Lab., Tenn.). *J. Opt. Soc. Amer.* 45, 63(1955) Jan.

Zeeman effects of plutonium were observed at a field strength of about 25,000 oersteds using an echelle spectrograph. Magnetic resolution of the order of 0.05-g units was obtained. More than two hundred Zeeman patterns show well-resolved structures in the wavelength range 2500 to 6900 Å. The great majority of patterns appear to be due to the singly ionized plutonium atom. (auth)

4112

ISOTOPIC EXCHANGE REACTIONS OF AMERICIUM.

Thomas K. Keenan, Robert A. Penneman, and John F. Suttle (Los Alamos Scientific Lab., N. Mex.). *J. Phys. Chem.* 59, 381(1955) Apr.

The isotopic exchange reactions between Am(III), Am(V), and Am(VI) were measured in HClO_4 as a function of metal ion concentration, hydrogen ion concentration, and temperature. The results of the exchange reactions between Am(III) and Am(V) were inconclusive. A rapid exchange of Am(V) and Am(VI) was noted in 1.0f HClO_4 . (C.W.H.)

URANIUM AND URANIUM COMPOUNDS

4113

A SELECTIVE PROCEDURE FOR THE GRAVIMETRIC ESTIMATION OF URANIUM AS OXINATE USING COMPLEXONE AS MASKING AGENT. R. N. Sen Sarma and A. K. Mallik (College of Engineering and Technology, Calcutta,

India). *Anal. Chim. Acta* 12, 329-34(1955) Apr. (In English)

The existing method for the estimation of U in hexavalent condition as oxinate has been slightly modified, and the scope of complexone (disodium salt of ethylenediaminetetraacetic acid) as a masking agent to develop a selective method for its estimation in presence of interfering elements has been studied. It has been found that at pH ranges from 5 to 9 complexone exerts no influence on the complete precipitation of uranium and that uranium can be quantitatively separated from Th, R.E., Zr, Fe^{+3} , Al, Cu, Co, Ni, Zn, Cd, Pb, Bi, Mn, and P_2O_5 by precipitation with oxine in a solution buffered with acetic acid and ammonium acetate (pH approximately 5.3) and also from V_2O_5 , MoO_3 , and WO_3 in ammoniacal medium (pH approximately 8.4). (auth)

ENGINEERING

4114 AD-46232

Consolidated Vultee Aircraft Corp.

METAL ADHESIVES DEVELOPMENT PROGRAM BI-MONTHLY PROGRESS REPORT. DEVELOPMENT OF PRODUCTION EQUIPMENT, METHODS, AND FABRICATION CRITERIA FOR METAL ADHESIVES. REPORT NO. 20 FOR PERIOD JUNE 1 THRU JULY 31, 1954. 57p. Contract AF33(600)-19263.

The effects of various flexible edge conditions on the stress concentrations present in overlap shear joints were studied. Various heat transfer fluids were evaluated for use in metal adhesive bonding presses. Improvement of adhesion of silicone rubber to glass fabric was studied. Castable insulating materials were evaluated for use in fabricating metal adhesive bonding presses. Application of pressure and heat to bond area only when bonding stiffeners to large webs was investigated. Compression panels bonded with various adhesives were evaluated. (J.E.D.)

4115 CCL-5.39

Cobb Chemical Lab., Univ. of Va.

[HYDRAULIC FLUIDS, LUBRICANTS, AND RELATED MATERIALS]. HIGH TEMPERATURE ANTIOXIDANTS FOR SYNTHETIC BASE OILS. EVALUATION OF ADDITIVES AND MECHANISM STUDIES. QUARTERLY PROGRESS REPORT [FOR] PERIOD ENDING MARCH 25, 1955. James W. Cole, Jr., Donald R. Campbell, and Robert N. Lawhorn. Mar. 1955. 31p. Contract AF 33(038)-22947.

A total of 61 additives were examined for antioxidant activity under oxidative conditions at 450 to 500°F in selected combinations in synthetic oil bases. Test squares of Ti, Cu, Si, cold-rolled steel, and Al were placed in the oxidation cells in some cases. Considerable attention was given to silicone fluids. The equipment needed for radiochemical studies of compounds containing C^{14} and S^{35} was assembled and calibrated. A method is described for the preparation of S^{35} -labeled phenothiazine for use in future studies on oxidation, antioxidants, and corrosion inhibitors. (C.H.)

4116 D-12245

Boeing Airplane Co.

PERFORMANCE OF SR-4 STRAIN GAGES UP TO 450°F. Emmett E. Day. Oct. 9, 1951. 56p. Contract AF 33(038)-19589.

The performance of bonded resistance-wire strain gages has been investigated in the temperature range from room temperature to 450°F. The gages were tested for stability,

zero shift, hysteresis, and gage-factor change. The procedures and equipment used in the tests are described. Twelve types of gages were tested, and the results are summarized. (M.P.G.)

4117 KAPL-973

Knolls Atomic Power Lab.

STRESSES IN A SEMI-INFINITE THIN-WALLED CYLINDER CAUSED BY AN EXPONENTIAL TEMPERATURE DISTRIBUTION. W. E. Cooper, M. T. Roche, and J. L. Noble. Mar. 25, 1955. 185p. Contract W-31-109-Eng-52.

The stresses in a long thin-walled circular cylinder subject to given conditions of end fixity and longitudinal temperature distributions have been studied. Two cases of end fixity have been considered, one in which one end is fixed in a rigid wall, and the other in which one end is pinned to a rigid wall. In both cases the other end is free. The temperature is constant for a certain length of the cylinder and then decreases exponentially. The techniques used in the stress analysis are described. Graphs are presented of normalized deflections and stresses as functions of axial distance. (M.P.G.)

4118 NP-5602

Johnston, Herrick L., Inc.

PRELIMINARY OPERATION MANUAL FOR PORTABLE HYDROGEN LIQUEFACTION PLANT. [1954?] 96p. Contract AF-29(601)-54.

4119 NP-5603

Johnston, Herrick L., Inc.

PRELIMINARY MAINTENANCE MANUAL FOR PORTABLE HYDROGEN LIQUEFACTION PLANT. [1954?]. 127p. Contract AF29(601)-54.

4120 NP-5608

Monsanto Chemical Co., Dayton

DEVELOPMENT OF HIGH TEMPERATURE BASE STOCK FOR HYDRAULIC FLUIDS AND LUBRICANTS. PROGRESS REPORT [FOR] PERIOD NOVEMBER 1954 THROUGH MARCH 15, 1955. Edward S. Blake, James W. Edwards, William C. Hammann, and Thomas E. Reichard. 28p. Contract AF 33(616)-2623.

Thirty-seven compounds were screened for thermal stability. Tertiary alkyl carbinol esters of sebacates have been shown to be remarkably more stable than *n*-alkyl sebacates. One new tertiary-alkyl carbinol, 2, 2, 4-trimethyl-1-pentanol, and seven new esters were synthesized. Nonyl phenyl carbonate was prepared and found unstable. A polyarylphosphonate as a V.I. improver for tricresyl phosphate appears to degrade on heating. The thermal stability screening test and the isoteniscope rank compounds within a class in about the same order. (auth)

4121 NP-5609

Cornell Univ.

INVESTIGATION ON PLASTIC BUCKLING FOR CASES OF SIMPLY SUPPORTED PLATES SUBJECTED TO NON-HOMOGENEOUS STRESS DISTRIBUTION. REPORT NO. 11 [FOR] PERIOD OF JANUARY 1-MARCH 31, 1955. P. P. Bijlaard. 3p. Contract DA-30-115-ORD-326.

The case of plastic buckling of long clamped plates under eccentric compression in their plane was solved earlier by writing the differential equation in terms of finite difference equations with second order differences, using nine spacings. In this note a brief discussion is given of the plastic reduction factor η , the ratio between

the plastic and buckling stresses for a given stress distribution. (L.M.T.)

4122 NP-5613

Mine Safety Appliances Co.

PERFORMANCE TESTS OF THERMAL INSULATION FOR SODIUM PIPING. MEMO REPORT NO. 72. Walter Millich, R. C. Andrews, and E. C. King. Dec. 31, 1954. 9p. Contract NObs-65426.

Samples of Kaolin Wool, LK-61, Superex, Thermoflex RF-1400, and Unibestos No. 1200 were immersed in Na under an inert atmosphere at 350, 500, and 850°F for 10-minute periods. At 850°F Na penetrated and charred all of the insulations. Kaolin Wool and Thermoflex were the least effected at the lower temperatures. Samples of baked and unbaked LK-61, Superex, and Unibestos No. 1200 were tested for mechanical strength under wet and dry conditions. Unibestos proved to be the strongest of the insulations tested in either wet or dry conditions. (auth)

4123 PI-323

Research Labs. Div., General Motors Corp.

A METHOD FOR BONDING OPTICAL GLASS PARTS TO METAL MOUNTS. FINAL REPORT. Alexander Somerville. May 13, 1954. 70p. (AD-42703)

A glass-to-Al bonding method has been developed in which the bond is formed at room temperature without the use of pressure. A thin sheet of natural rubber is incorporated between the glass and Al surfaces to absorb the dimensional changes which accompany changes in temperature. Detailed instructions for producing the bonds are included. Testing procedures are described, and the test results are summarized. (M.P.G.)

4124 PWAC-101

Pratt and Whitney Aircraft Div.

THE EFFECT OF INTERNAL PRESSURE ON THE FLEXIBILITY OF LARGE-RADIUS PIPE BENDS. W. W. Barton and A. W. Starbird. June 1, 1954. 43p.

A theoretical and experimental investigation has been made of the effect of internal pressure on the flexibility of a large-radius pipe bend. This information was considered necessary for the flexibility and stress analysis of a high-pressure piping system which was to be designed for maximum flexibility and minimum weight. The test specimen consisted of a heat-treated U-bend of 6-in. standard weight pipe. Bending moments up to 250,000 in.-lbs were applied to the bend when it was under internal pressures up to 2,750 psi. The deflection of the bend was measured with a micrometer dial gauge, and the strains on the outer surface of the pipe were obtained at 28 locations with strain gage rosettes. The flexibility and stress-intensification factors calculated from the test data have been compared with theoretical equations. These comparisons are considered to be good in view of the initial out-of-roundness of the fabricated bend. (auth)

AEROSOLS

4125

PERFORMANCE CHARACTERISTICS OF CENTRIFUGAL SCRUBBERS. Glenn A. Johnson, Sheldon K. Friedlander, Richard Dennis, Melvin W. First, and Leslie Silverman (Harvard School of Public Health, Boston, Mass.). *Chem. Eng. Progr.* 51, 176-88(1955) Apr.

The performance characteristics of two wet separating devices—an experimental cyclonic scrubber and a commer-

cial dynamic scrubber—are described. Collection efficiencies, power requirements, and air flow pattern and dust distribution are discussed. The development of wet collection units that would permit continuous and remote-control removal of radioactive aerosols is anticipated. (C.W.H.)

HEAT TRANSFER AND FLUID FLOW

4126 AD-6916

Bureau of Mines, Fuels Technology Div., Pittsburgh
FLOW PROPERTIES OF FINE PARTICLES. QUARTERLY REPORT [COVERING THE PERIOD OCTOBER 1, 1952 TO DECEMBER 31, 1952]. Murray Weintraub. Jan. 1953. 19p. Contract CD2-4014.

Progress is discussed on the analysis of data for vertical flow of a dense bed through an orifice and the design of apparatus for further study of the problem. A report is also given on the size and size distribution of 3 powdered materials suitable for flow studies. Tentatively it was concluded that in the flow of solids downward through an orifice, co-current flow of gas increases the rate of solids flow considerably, but counter-current gas flow provides a much more uniform and reproducible flow rate. The pressure drop of the gas is apparently a complex function of gas rate, solids rate, and orifice opening. The solids stream has the ability to transfer gas from a region of low pressure to one of high pressure. The ratio of gas flow to solid flow is independent of the orifice opening. (auth)

4127 AD-37130

Syracuse Univ.

GAS FLOW IN CAPILLARIES OF NON-CIRCULAR CROSS SECTION. C. H. Bachman and P. A. Silberg. June 24, 1954. 8p. Contract DA-30-115-ORD-331, Technical Report No. 2.

Flow rates of gas may be determined by measuring the drop in pressure across a capillary through which the gas flow Poiseuille's relation describes the flow rate in terms of this pressure drop. The small pressure difference resulting from very low flow rates limits the method. Increased sensitivity with a given capillary may be obtained by inserting a rod or wire in the capillary bore. This not only decreases the effective bore but changes the cross section shape, and the usual Poiseuille equation derived for a circular cross section cannot be applied directly. Capillaries modified in this manner have been examined experimentally and theoretically. (auth)

4128 AERE-ED/R-1559

Atomic Energy Research Establishment, Harwell, Berks (England)

THERMAL CONVECTION IN A LONG CELL CONTAINING A HEAT GENERATING FLUID. W. Murgatroyd. Nov. 18, 1954. 20p.

Fully developed temperature and velocity profiles have been evaluated for laminar and turbulent flow in a long vertical cylindrical or parallel-sided cell containing a heat generating fluid, and having isothermal walls. Values of the turbulent diffusivities have been taken from experimental results in forced convection channel flow. The reciprocal Nusselt number has been plotted against Grashof number. It is shown that in a highly rated nuclear reactor having a liquid metal fuel element, the heat transfer coefficient may be increased by about 60% by turbulence. If an aqueous solution is employed, turbulence can improve the heat transfer coefficient about twelve times.

The effect of magneto-hydrodynamic forces on the flow in a model liquid metal cell using ohmic heating is briefly considered. (auth)

4129 JPL-Memo-20-88

Jet Propulsion Lab., Calif. Inst. of Tech.

A STUDY OF THE MECHANISM OF BOILING HEAT TRANSFER [thesis]. Max Edmund Ellion. Mar. 1, 1954. 88p. Contract DA-04-495-ORD-18.

The conventional laboratory equipment for studying boiling heat transfer was modified so that it could be operated in a stable manner with subcooled liquids in the regions of nucleate, partial film, and complete film boiling. The apparatus employed a secondary stabilizing fluid which flowed through the inside of an electrically heated stainless steel tube while the test fluid was flowing through an annulus formed by the tube and a Pyrex jacket. The stabilizing fluid absorbed the excess heat which could not be transferred to the test fluid. This arrangement allowed the apparatus to operate safely in all three boiling regions since the total heat transferred to the stabilizing fluid and the test fluid was a monotonically increasing function of wall temperature up to the melting point of the wall. The equipment retained the simplicity of electrical heating and was used to study boiling in distilled water which was flowing at various velocities, pressures, and temperatures in an annulus. The results of this investigation and a description of the apparatus are presented together with an approximate method for calculating the heat transfer in the complete film boiling region. High-speed motion pictures that were taken of the degassed water boiling on the electrically-heated tube showed the types of vapor formation in the three boiling regions. The mechanism of transition from nucleate to partial film and finally to complete film boiling as the wall temperature was increased is discussed. The second phase of the investigation consisted of a study of pool boiling using distilled water and commercially pure carbon tetrachloride. The experimental program was aimed at obtaining fundamental information on the behavior of nucleate bubbles forming on a stainless-steel heating strip and the role they play in boiling heat transfer. High-speed motion pictures were taken of the nucleate bubbles at a liquid pressure of one atmosphere, liquid temperature range from 170°F below saturation to saturation temperature, and heat fluxes from incipient boiling to the transition from nucleate to partial film boiling. In addition, the effects of dissolved gas and surface tension on bubble dynamics were studied. As a result of this program it has been possible to propose a mechanism for the growth and collapse of nucleate bubbles. An empirical expression has been obtained that relates the measured bubble velocity and size to the heat flux at the transition from nucleate to partial film boiling. This relation is $Nu = 0.053 Re^{0.6} Pr$. The velocity and effective diameter appearing in this equation still have to be determined experimentally; all other factors are liquid properties. The values of the peak heat transfer calculated from this relation agree within 15% with the experimental data. (auth)

4130 M-TR-10

Illinois Univ.

INCOMPRESSIBLE AND COMPRESSIBLE MIXING OF STREAMS. THEORETICAL STUDIES OF THE MIXING PROCESS OF A JET IMPINGING INTO A STREAM OF LARGE MASS. ANNUAL SUMMARY. T. P. Torda. June

15, 1954. 38p. Contract AF33(038)-21251. (AD-36555)

Theoretical analyses which have been carried out on incompressible laminar and turbulent and compressible mixing are summarized. A wind tunnel and shock tube that will be used for experimental observations are described. (L.M.T.)

4131 NACA-RM-E54K10

Lewis Flight Propulsion Lab., NACA

SOME MEASUREMENTS OF BOILING BURN-OUT. Warren H. Lowdermilk and Walter F. Weiland. [Nov. 23, 1954]. 19p.

Measurements of boiling burn-out heat flux for water flowing upward through an electrically heated tube were obtained for ranges of velocity from 0.1 to 19 fps; pressure from atmospheric to 2000 pounds psi; length-diameter ratios of 25, 37.5, and 50; and inlet subcooling from zero to 400°F. Unsteady flow was obtained for burn-out conditions with a restriction located downstream of the point of burn-out. A compressible fluid plenum chamber located between the restriction and the exit of the test section resulted in steady-flow burn-out with a tenfold increase in the burn-out heat flux. (auth)

4132 NACA-TN-3045

Lewis Flight Propulsion Lab., NACA

ANALOGY BETWEEN MASS AND HEAT TRANSFER WITH TURBULENT FLOW. Edmund E. Callaghan. [Aug. 12, 1953]. 19p.

An analysis of combined heat and mass transfer from a flat plate has been made in terms of Prandtl's simplified physical concept of the turbulent boundary layer. The results of the analysis show that for conditions of reasonably small heat and mass transfer, the ratio of the mass- and heat-transfer coefficients is dependent on the Reynolds number of the boundary layer, the Prandtl number of the medium of diffusion, and Schmidt number of the diffusing fluid in the medium of diffusion. For the particular case of water evaporating into air, the ratio of mass-transfer coefficient to heat-transfer coefficient is found to be slightly greater than unity. (auth)

4133 AERE-Lib/Trans-479

TYPES OF FLOW OF GAS/LIQUID MIXTURES IN HORIZONTAL PIPES. M. A. Molugin. Translated by V. Beak from *Doklady Akad. Nauk S.S.S.R.* 94, 807-10(1954). 6p.

Detailed visual observations and cinematographic photos were made of the flow of air/water mixtures in horizontal pipes of diameters \approx 25, 50, 75 and 100 mm, and in the range of gas contents, C_{op} , from 0 to 1. Velocities of the mixture ranged from 0.2 to 6 m/sec, and up to 20 m/sec for the pipe of diameter \approx 50 mm, with pressures of \approx 1.8 to 2 atm at the entry and \approx 1.3 atm. at the outlet. This investigation made it possible to construct the first accurate charts of the ranges of the flow types of gas/liquid mixtures, and to draw a number of conclusions as to their behavior. (auth)

4134 NACA-TM-1308

ON MOTION OF FLUID IN BOUNDARY LAYER NEAR LINE OF INTERSECTION OF TWO PLANES (O Dvizhenii Zhidkosti v Pogranichnom Sloe Vblizi Linii Peresechenia Dvukh Ploskostei). L. G. Loitsianskii and V. P. Bolchakov. Translated by S. Reiss from *Trans. Central Aero-Hydrodynamical Inst. Rpt.* 279, 3-18(1936) 27p.

A motion of a slightly viscous incompressible fluid that flows between two semi-infinite planes which intersect at an angle between 0 and 180° is discussed. The increase in

thickness of the boundary layer near the line of intersection of the two planes, the limits of the effect of the corner, and the effect on the drag are determined. The analysis is made for both laminar and turbulent flow by using the momentum theorem and assuming suitable velocity profiles. (auth)

4135

CONDENSATION OF FLOWING STEAM ON A PLANE SURFACE. G. G. Chernyi. *Doklady Akad. Nauk S.S.S.R.* 101, 39-42(1955) Mar. 1. (In Russian)

RADIOGRAPHY

4136

GAMMA-RADIOGRAPHY IN OIL STORAGE INSTALLATIONS. III. C. C. Bates (Welding Supervision Ltd., London). *Atomics* 6, 62-5(1955) Mar.

The application of radiographic nondestructive inspection to pipeline welds is discussed. (Part II appears in *Atomics* 6, 5-8(1955) Jan.) (C.W.H.)

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

4137 AD-38003

Illinois Univ.

HIGH TEMPERATURE RESISTANT CERAMIC COATINGS, CERAMIC AND METAL CERAMIC BODIES. PROGRESS REPORT NO. 1 [COVERING THE PERIOD MARCH 16, 1954 TO JUNE 26, 1954]. [Dwight G. Bennett, Tracy A. Willmore, and W. J. Plankenhorn]. June 26, 1954. 20p. Contract AF 33(616)-2307.

The progress made in a number of investigations pertaining to ceramic coatings applied to metals and to ceramic and metal ceramic bodies is reported. Refractory ceramic coatings were found to be more durable and to retain their protective properties, when applied to low alloy content metals, at considerably higher temperatures than porcelain enamel ground coats. Variations in the degree of smelting of the frit and maturing of the coating were found to affect coating durability. The effects of ceramic coatings on the fatigue and stress rupture characteristics of 18-8 stainless steel type 321 are shown. Future plans and the results of preliminary investigations in the development of cermet bodies with high metal content are given. (auth)

4138 AD-46020

American Lava Corp.

A STUDY AND EVALUATION OF METHODS OF PRODUCING A CERAMIC-TO-METAL SEAL BY PRESSED POWDER TECHNIQUES FOR AUTOMATIC MASS PRODUCTION. MONTHLY REPORT NO. 1 FOR THE PERIOD AUGUST 16, 1954 TO OCTOBER 1, 1954. Harry C. Dunegan. Oct. 1954. 17p. Contract AF33(600)-27329.

An investigation of the possibility of forming vacuum-tight ceramic-to-metal seals by powder techniques has been initiated. The seals are to be a result of the bond formed by the simultaneous sintering or maturing of powdered metal layers in contact with pressed powder ceramics. Difficulties in maturing commercial alumina, zircon, porcelain, forsterite, and steatite formulations in a

hydrogen atmosphere are mentioned. Descriptions of bonds between Type 302 stainless steel and forsterite and alumina bodies, together with the defects encountered, are discussed. The design of a relatively inexpensive atmosphere furnace capable of operation at 1500°C is described. A purification system suitable for removing oxygen and water vapor from hydrogen and hydrogen-helium mixtures is reported. Cast alumina boats, designed for use in hydrogen atmosphere tube furnaces have been constructed and modifications necessary in adapting existing equipment to the anticipated project requirements are discussed. A description of the proposed approaches is also included. (auth)

4139 AD-51831

Illinois Univ.

HIGH TEMPERATURE RESISTANT CERAMIC COATINGS, CERAMIC AND METAL CERAMIC BODIES. QUARTERLY PROGRESS REPORT NO. 2 [COVERING THE PERIOD JUNE 26, 1954 TO SEPTEMBER 26, 1954]. Clarence L. Hoenig, Tracy A. Willmore, W. J. Plankenhorn, and Dwight G. Bennett. Sept. 26, 1954. 16p. Contract AF 33(616)-2307.

The characteristics and physical properties of various low alloy content metals which were suggested for consideration for high temperature use in aircraft power plants are reviewed. The results of preliminary approaches to the possibility of developing radiation reflective coatings for direct application to metal by the intimate mixing of the refractory material into the molten frit batch are described. The progress being made in the development test equipment for the evaluation of metal-titanium diboride cermets is noted. An investigation of oxygen deficient ceramic oxides as the non-metallic phase of cermets was completed with the conclusions that the use of partially reduced oxides of TiO_2 , ZrO_2 , and CeO_2 did not in general produce bodies superior to those in which the normal oxides were used. In the case of partially reduced TiO_2 , however, the modulus of rupture strength was increased by more than 11%. (auth)

4140 NACA-RM-E54D13

Lewis Flight Propulsion Lab., NACA

A DROP TEST FOR THE EVALUATION OF THE IMPACT STRENGTH OF CERMETS. B. Pinkel, G. E. Deutsch, and N. H. Katz. [Feb. 15, 1955]. 8p.

The development of brittle high-temperature materials has focused attention on the impact resistance of these materials. This report describes a device for measuring very small values of impact resistance both at normal and elevated temperatures. The device is believed to eliminate extraneous energies, such as the "toss energy" from the impact strength. The method of testing consists of dropping a hammer from increasing heights so that it strikes near the free end of a cantilever beam specimen. The energy of the hammer when the specimen fractures is the impact strength. Representative values of the impact strengths of several high-temperature materials are given. (auth)

4141 NP-5600

Brush Labs. Co.

AGING IN BARIUM TITANATE CERAMICS. TECHNICAL REPORT NO. 4. Don Berlincourt. Mar. 30, 1955. 23p. Contract Nonr-1055(00).

The aging behavior, factors influencing aging, aging of

commercially prepared discs, and aging under advance conditions of a large number of $BaTiO_3$ ceramic specimens were measured. Results indicate that small changes in electromechanical coupling and dielectric constant occur from four to seven years after poling. (J.E.D.)

CORROSION

4142 NACA-TN-3333

Lewis Flight Propulsion Lab., NACA

CORROSION OF METALS OF CONSTRUCTION BY ALTERNATE EXPOSURE TO LIQUID AND GASEOUS FLUORINE. Richard M. Gundzik and Charles E. Feiler. [Sept. 28, 1954]. 11p.

The corrosion of 3S-0 and 52S-0 aluminum, AISI 347 and 321 stainless steels, "A" nickel, and low-leaded brass has been determined from the weight change of specimens exposed alternately to liquid and gaseous fluorine. Experiments were continued for a total exposure time of up to $3\frac{1}{2}$ months. It was found that corrosion is negligible under the conditions of the experiments. No visual differences were observed between those surfaces exposed to the gaseous phase only and those exposed to both the liquid and the gaseous phases. (auth)

4143 AD-38791

RESEARCH IN CORROSION OF METALS. (Issledovaniya po Korrosii Metalov). Trans. of Trudy Instituta Fizicheskoi Khimii, vypusk 2, 1951. 430p. (F-TS-8030 A/V)

A collection of papers on the mechanism of corrosion in metals, especially Al, is presented. Special attention is given to the roles of the protective film and nature of the solvent in corrosion. The concept of intercrystalline corrosion is treated in detail. (C.W.H.)

4144

PROTECTIVE COATINGS FOR METALS. R. M. Burns and W. W. Bradley. New York, Reinhold Publishing Corp., 1955. 643p.

This constitutes a revision of a book of the same title by Burns and Schuh, published in 1939. A review of historical developments is supplemented by a description of current advances in research and development since the first edition. The organics coatings chapters have been considerably expanded, with greater detail on performance and evaluation. (L.M.T.)

GEOLOGY AND MINERALOGY

4145 AECU-3024

Battelle Memorial Inst.

THE AMMONIUM CARBONATE LEACHING OF URANIUM ORES PROPOSED AS FEED TO THE PILOT PLANT AT GRAND JUNCTION, COLORADO. PROGRESS REPORT. C. M. Wheeler, B. G. Langston, and F. M. Stephens, Jr. Apr. 15, 1955. 11p.

Data obtained from an investigation of the amenability of Cal-uranium, asphaltic, and limestone ores to $(NH_4)_2CO_3$ leach to extract U are discussed. An $(NH_4)_2CO_3$ pressure leach was found capable of extracting 95% of the U from each of the ores. Precipitation studies made on the pregnant liquor obtained from the small-scale studies showed that over 99% of the U in the liquors can be recovered in a product assaying 77 to 82% U_3O_8 and about 11% V_2O_5 . (J.E.D.)

4146 TID-5156

Raw Materials Development Lab., American Cyanamid Co. Atomic Energy Div.

THE TECHNIQUE OF ACID PUGGING AND CURING OF ORES. D. C. McLean. June 30, 1953. Decl. Mar. 17, 1955. 17p.

A report is presented on hydrometallurgical research involving the pugging and curing of U ores. The process consists of mixing an ore with strong H_2SO_4 and other reagents at a total solids content of 80 to 90%, which permits selective decomposition of silicate minerals in high lime ores using a minimum amount of acid. The factors involved in pugging and curing are the amount of acid and water used, temperature and time of cure, and the mesh size of the ore. A tentative method for determining U(VI) is given. (J.E.D.)

4147

PHOTOGEOLOGIC MAP OF THE CIRCLE CLIFFS-5 QUADRANGLE, GARFIELD COUNTY, UTAH. MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP I-21. J. S. Dettnerman. Washington, U. S. Geological Survey, 1955. \$0.50.

4148

PHOTOGEOLOGIC MAP OF THE CIRCLE CLIFFS-6 QUADRANGLE, GARFIELD COUNTY, UTAH. MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP I-22. R. J. Hackman. Washington, U. S. Geological Survey, 1955. \$0.50.

4149

PHOTOGEOLOGIC MAP OF THE CIRCLE CLIFFS-7 QUADRANGLE, GARFIELD COUNTY, UTAH. MISCELLANEOUS GEOLOGIC INVESTIGATIONS MAP I-23. R. J. Hackman. Washington, U. S. Geological Survey, 1955. \$0.50.

4150

PRELIMINARY GEOLOGIC MAP OF THE HAMM CANYON QUADRANGLE, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF 21. Fred W. Cater, Jr. Washington, U. S. Geological Survey, 1955. \$0.25.

4151

PRELIMINARY GEOLOGIC MAP OF THE PARADOX QUADRANGLE, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF 22. C. F. Withington. Washington, U. S. Geological Survey, 1955. \$0.25.

4152

PRELIMINARY GEOLOGIC MAP OF THE EGNAR QUADRANGLE, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF 26. Fred W. Cater, Jr. Washington, U. S. Geological Survey, 1955. \$0.25.

4153

PRELIMINARY GEOLOGIC MAP OF THE JOE DAVIS HILL QUADRANGLE, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF 27. Fred W. Cater, Jr. Washington, U. S. Geological Survey, 1955. \$0.25.

4154

PRELIMINARY GEOLOGIC MAP OF THE DAVIS MESA QUADRANGLE, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF 31. Fred W. Cater, Jr. and E. J. McKay. Washington, U. S. Geological Survey, 1955. \$0.25.

4155

PRELIMINARY GEOLOGIC MAP OF THE CALAMITY MESA QUADRANGLE, COLORADO. MINERAL INVESTIGATIONS FIELD STUDIES MAP MF 32. Fred W. Cater, Jr. Washington, U. S. Geological Survey, 1955. \$0.25.

4156

GEOLOGY OF THE QUARTZ CREEK PEGMATITE DISTRICT, GUNNISON COUNTY, COLORADO. Mortimer H. Staatz and Albert F. Trites. U. S. Geol. Survey Profess. Paper 265, 1955. 111p.

The general geology of the Quartz Creek Pegmatite District, the structure, types, and mineralogy of pegmatites, descriptions of individual deposits, and the relationship of beryl-bearing pegmatites are discussed. (J.E.D.)

METALS AND METALLURGY

4157 AD-34358

Illinois Univ.

THE EFFECT OF DIFFERENT STATES OF STRESS ON THE FATIGUE OF MATERIALS WITH CORRECTION FOR ANISOTROPY; AND THE BASIC LAWS GOVERNING FAILURE UNDER COMBINED STRESS. TECHNICAL REPORT NO. 4. EXPERIMENTS IN FATIGUE UNDER RANGES OF STRESS IN TORSION AND AXIAL LOAD FROM TENSION TO EXTREME COMPRESSION. William N. Findley. May 1954. 28p. Contract DA-11-022-ORD-995.

Axial-load fatigue tests were performed on SAE 4340 steel at mean stresses from 40,000 psi in tension to 135,000 psi in compression (a stress equal to the tensile strength). Elaborate precautions were taken to ensure axial loading of specimens. In the extreme compression tests the entire stress cycle was a compression stress of 20,000 psi or greater. This was done to determine whether fatigue cracks could form and propagate in a cycle containing no tensile stresses—even from residual stresses. A technique for doubling the yield point in compression was also demonstrated and used in these fatigue tests. An experiment was also performed on 75 S-T aluminum alloy to determine whether the large effect of mean stress on the fatigue strength in tension, and in torsion was due to the change in structure of the material resulting from inelastic action or to other causes. A similar test was made of the same alloy in torsion fatigue to evaluate the influence of the complementary normal stress. (auth)

4158 AD-34359

Illinois Univ.

THE EFFECT OF DIFFERENT STATES OF STRESS ON THE FATIGUE OF MATERIALS WITH CORRECTION FOR ANISOTROPY; AND THE BASIC LAWS GOVERNING FAILURE UNDER COMBINED STRESS. TECHNICAL REPORT NO. 3. ANISOTROPY OF FATIGUE STRENGTH IN BENDING AND IN TORSION OF A STEEL AND TWO ALUMINUM ALLOYS. W. N. Findley and P. N. Mathur. Apr. 1954. 38p. Contract DA-11-022-ORD-995.

An investigation of anisotropy in fatigue, under two different states of stress, bending and torsion, was made of two aluminum alloys and a steel. A somewhat similar trend was observed in the variation of the fatigue strengths with orientation relative to the texture, for all three metals. The fatigue strength in bending decreased as the orientation changed from longitudinal to diagonal to transverse and the fatigue strength in torsion was nearly constant at all three orientations. The results of the test are explainable from the concept that cyclic principal shear is primarily the cause of fatigue but the ability of the anisotropic materials to withstand this action of cyclic shear stress is influenced by the magnitude and the direction of the complementary normal stress acting on planes of principal shear stress. Since the anisotropy was observed to be different for the

two states of stress, bending and torsion, the combined stress theories of fatigue failure, based on linear superposition of the stress fields in bending and torsion, warrant a correction for anisotropy. (auth)

4159 AD-34434

Illinois Univ.

THE EFFECT OF DIFFERENT STATES OF STRESS ON THE FATIGUE OF MATERIALS WITH CORRECTION FOR ANISOTROPY; AND THE BASIC LAWS OF GOVERNING FAILURE UNDER COMBINED STRESS. TECHNICAL REPORT NO. 5. MODIFIED THEORIES OF FATIGUE FAILURE UNDER COMBINED STRESS. W. N. Findley and P. N. Mathur. May 1954. 27p. Contract DA-11-022-ORD-995.

An examination of the results of many fatigue investigations in bending and torsion indicates that the observed values of the ratio b/t for engineering materials vary over a wide range. For metals alone the fatigue strength ratio b/t varies approximately between 0.9 and 2.6. However, if different classes of metals are grouped together the range of values of b/t within each grouping is much smaller. The following groupings were made: (a) cast irons and iron alloys, (b) unnotched steels and aluminum alloys, (c) notched steels, (d) copper alloys, and (e) plastic laminates. (auth)

4160 AD-35043

Metallurgical Labs., Dow Chemical Co.

HIGH STRENGTH WROUGHT Mg ALLOYS. PART A. WORK SOFTENING-ANNEAL HARDENING CHARACTERISTICS OF Mg-BASE ALLOYS CONTAINING Th, MM, Ca, Mn, AND Zr. PART B. COLD WORKING CHARACTERISTICS OF BINARY Mg ALLOYS. FINAL REPORT [FOR] JUNE 30, 1952-DECEMBER 31, 1953. 114p. Contract DA-20-018-ORD-12457.

Work-softening and anneal-hardening characteristics of Mg-base alloys containing Th, MM, Ca, Mn, and Zr and cell Mg were investigated. All of the alloys were found to soften during cold rolling and, except for Mg-Zr and cell Mg, the alloys harden upon subsequent annealing for 1 hr at 400°F. Variations in the cold working of Mg-MM-Zr alloy show the work softening process to be somewhat directional. The strength properties of anneal-hardened Mg-MM-Zr are lowered by subsequent cold rolling. Pole figures were determined on Mg-MM-Zr, Mg-Mn-MM, and Mg-Th alloys. Electron microscope and diffraction studies show that precipitation increases during the work softening-anneal hardening process. A discussion of the work softening-anneal hardening process is presented on the basis of solid-solution hardening, stabilization of fault planes, and precipitation hardening. (J.E.D.)

4161 AD-35044

Metallurgical Labs., Dow Chemical Co.

PRINCIPLES OF THE EFFECT OF RARE EARTH ADDITIONS ON THE HIGH TEMPERATURE PROPERTIES OF MAGNESIUM. PHASE II. QUARTERLY REPORT NO. 5 FOR THE PERIOD APRIL 1, 1953 TO JUNE 31, 1953. REPORT NO. 15657. 8p. Contract AF 33(038)-16655.

A series of magnesium-aluminum binary alloys containing nominally 5, 10, and 15% aluminum has been prepared. Creep testing has been started on the 10.3 Al alloy in the solution heat-treated and aged condition. A conversion to approximately constant stress testing conditions has been carried out. The presence of precipitate at the grain boundary in the 0.7% cerium alloy, which has

maximum creep resistance in the binary series, has been proved directly with electron micrographs and correlated photomicrographs. Lineal analysis of a series of Mg-Th alloys has shown the solubility of thorium in solid electrolytic magnesium at 1050°F to be 4.1 ± 0.5 wt. %. (auth)

4162 AD-37226

Massachusetts Inst. of Tech.

VAPOR DEPOSITED COATINGS. FINAL REPORT. David A. Stevenson, Stanley T. Wlodek, and John Wulff. June 30, 1954. 44p. Contract DA-19-020-ORD-837.

The superior strength and erosion resistance of Mo metal at high temperatures recommends the use of Mo coatings for many applications. Previous work has shown that coatings of Mo may be obtained by the hydrogen reduction of molybdenum pentachloride vapor at temperatures of 900°C and pressures of 20 to 40 millimeters of mercury. The major problems associated with this method are the following: poor mechanical strength of the plate resulting from columnar grain structure; poor adhesion of the coating to the base metal; and general experimental difficulties. The main subject of this report is the discussion of the work done in improving and analyzing the adhesion of vapor deposited molybdenum to base metals. A method of testing and evaluating adhesion of vapor-deposited Mo was developed. As a result of earlier studies of adhesion, it was found that oxide contamination prevented good adhesion. The plating technique was modified until oxide-free molybdenum coatings were obtained. Using this plating technique, adhesion was studied as a function of the base metal and surface preparation. Adherent coatings were obtained on Cu, Co, Ni, Inconel, and Rh. Successful bonding of the plate could not be achieved on Fe, plain carbon and stainless steels, or Cr-impregnated surfaces. Adherent coatings were, however, obtained on Fe and plain carbon steel by first electroplating with Ni, Cu, Co, or Rh. Samples preparation must be such as to provide a clean and uncontaminated surface. Sandblasting and other treatments which tend to imbed foreign material must be avoided. An analysis of the variables which influence the bond between vapor-deposited molybdenum and the base metal is presented. There appears to be a correlation between the adherence of the coating and the resistance of the base metal to oxide formation and chloride attack. Factors such as the widths and hardnesses of the intermetallic phases were found to have, at best, a secondary effect on the adherence of the vaporplated coatings. (auth)

4163 AD-37293

Powder Metallurgy Lab., Rensselaer Polytechnic Inst. ALUMINUM POWDER METALLURGY. PROGRESS REPORT FOR FIFTH QUARTER, NOVEMBER 24, 1953 TO FEBRUARY 23, 1954. F. V. Lenel, A. B. Backensto, and M. V. Rose. Mar. 31, 1954. 42p. Contract AF33(616)-351.

Production and testing of extruded rods from flake powders having average flake thicknesses of 0.8 and 4 microns is described. Comparison of these tests with the results of tests previously described for aluminum powder extrusions indicates that the strength at 400°C depends on the oxide distribution; the strength at room temperature depends chiefly on the oxide content; higher strengths have been attained by extrusions produced at R.P.I. than by extrusions produced by AIA-G or ALCOA at either temperature of testing; the ductility as shown by the elongation to strength ratio is lower for extrusions produced at R.P.I.

when compared with the products of AIA-G and ALCOA for room temperature tests but is the same as the extrusions produced by AIA-G when both are tested at 400°C. Preliminary measurements of the surface of flake powders by the absorption of krypton on the surface have indicated that the specific surface is 4 to 14 times the covering capacity and that the specific surface determined is affected by the residual fatty acid. (auth)

4164 AD-37294

Powder Metallurgy Lab., Rensselaer Polytechnic Inst. ALUMINUM POWDER METALLURGY. PROGRESS REPORT FOR SIXTH QUARTER, FEBRUARY 24, 1954 TO MAY 23, 1954. F. V. Lenel, M. V. Rose, A. B. Backensto, and G. S. Ansell. June 17, 1954. 46p. Contract AF33(616)-351.

Investigations included production and testing of extrusions from flake powders of 0.7, 0.9, and 2.3-micron flake thickness and from -325 mesh atomized powder; tests on extrusions after heating 100 hr at 400°C; determination of transverse and longitudinal strength properties; description of powder treatment to increase the oxide content; results of x-ray investigations of preferred orientation; description of etching and replication techniques on extrusions for electron and light microscopy. (For preceding period see AD-37293.) (auth)

4165 AD-37295

Powder Metallurgy Lab., Rensselaer Polytechnic Inst. ALUMINUM POWDER METALLURGY. ANNUAL SUMMARY REPORT FOR PERIOD NOVEMBER 24, 1952 TO NOVEMBER 23, 1953. F. V. Lenel, A. B. Backensto, M. V. Rose, and G. S. Ansell. Feb. 24, 1954. 54p. Contract AF33(616)-351.

As received flake powders cannot be compacted because they are coated with fatty acid. Ether and petroleum ether remove some of the fatty-acid lubricant from the flake powders but the solvent-treated powders can not be compacted. Various heating treatments, such as heating in air at 150°C or heating in a vacuum between 375 and 400°C make the flake powder compactible. These treatments cause an increase in the oxide content of the powder, but, by controlling the atmosphere and the degree of vacuum, this increase can be controlled. Cold compacting, hot pressing, and extrusion of the treated flake powders were carried out using procedures very similar to those described by the Swiss. Cold compacting at 25 tsi produces compacts with green densities of about 2.2 g/cc. Hot pressing at 25 tsi and 1000°F raises the densities to between 2.6 to 2.7 g/cc, and extrusion to form a $\frac{1}{4}$ " rod at 1000°F with a reduction in area of 16:1 produces a final density between 2.7 and 2.8 g/cc. High extrusion speeds of the order of 80 in./minute are necessary to obtain extruded rods which are sound and have smooth surfaces. The ultimate tensile strength and elongation were measured at room temperature and at 400°C. In general, it appears that the oxide distribution is more important than the oxide content in the mechanism of strengthening at 400°C, but there appears to be some dependence of room temperature tensile strength on oxide percentage. The elongation at both room temperature and 400°C decreases as the strength increases. The results of hardness tests, in general, parallel the results of the strength tests. Work was begun on the preparation of extruded rods for electron microscope examination in order to determine the oxide distribution from the microstructure. (auth)

4166 AD-37311

Massachusetts Inst. of Tech.

RESEARCH ON MECHANICAL PROPERTIES OF SINTERED ALUMINUM POWDER. I. WROUGHT NICKEL-ALUMINUM PRODUCTS FOR HIGH TEMPERATURE USE. II. OXIDE-METAL STRUCTURE STUDIES. PROGRESS REPORT NO. 6 FOR THE PERIOD JANUARY 1954 TO APRIL 1954. Walter Cremens, Oliver Preston, and Nicholas J. Grant. 9p. Contract AF33(616)-284.

Results of the rupture testing at 1500°F of several Al-Ni alloys and Al-Al₂O₃-Ni systems are reported. Attempts to mechanically mix Cu powder and silica are discussed. (C.W.H.)

4167 BM-RI-5126

Bureau of Mines

ULTRASONIC INSPECTION OF ARC-CAST ZIRCONIUM AND ITS ALLOYS. F. W. Wood and J. O. Borg. Mar. 1955. 8p.

The method may be used to delineate irregularities, inclusions, porosity, or shrink holes in ingots up to 48 in. in length. Routine testing does not require technical personnel, and the equipment is easily maintained. (auth)

4168 COA-84

College of Aeronautics, Cranfield (England)

INVESTIGATION INTO THE MACHINING OF TITANIUM 150A IN THE FORGED STATE. J. T. D. Holt and J. Purcell. Aug. 1954. 26p. (AD-43697)

Tests to investigate various aspects of machining have been carried out on Titanium-150A, hot forged by High Duty Alloys. Measurements were made of the drilling forces, and an investigation of the cutting force when turning the blank was made. Tests were also made to determine the effect on tool life of tool shape, cutting speeds, of various rates of feed and of cutting lubricants and coolants. Conclusions are drawn as to the best tool angles for roughing and finish machining, the best tool grades for turning Ti-150A, and suitable speeds, feeds, and lubricants. (auth)

4169 KAPL-1309

Knolls Atomic Power Lab.

THE CAUSE OF BRITTLE FAILURE OF NICKEL-MANGANESE BRAZING WIRE AND RECOMMENDATIONS FOR ITS PREVENTION. W. E. Seymour, H. T. Sumsion, L. M. Osika, J. F. Duffey, and L. S. DeLuca. Feb. 12, 1955. 23p. Contract W-31-109-Eng-52.

The causes have been found for the brittle failure of a nominal 60 wt.% brazing alloy prior to use. The first cause is the precipitation of a face-centered-tetragonal phase of Mn-Ni in the grain boundaries of a face-centered-cubic matrix. The reaction of the tetragonal theta phase to form body-centered-cubic beta occurs with increasing temperature at 525°C, not 675°C, as the equilibrium diagram indicates. Cooling the alloys at 1½°C per minute to form as much theta phase as possible results in the alloy becoming glass-brittle. A second cause contributing to the brittle failure is the localized mechanical failure of the material during swaging and drawing operations which form short "spike-like" microcracks normal to the wire surface. The cracks generally intersect the surface, and the density has been observed to be approximately 10 per linear inch of wire. The cracks occur intermittently along the length of the wire. It was found that changing the composition from 60 to 70% Mn prevented the brittle failure of the wire. (auth)

4170 NACA-TN-3216

Subcommittee on Heat-Resisting Materials, NACA
COOPERATIVE INVESTIGATION OF RELATIONSHIP
BETWEEN STATIC AND FATIGUE PROPERTIES OF
WROUGHT N-155 ALLOY AT ELEVATED TEMPERA-
TURES. [June 15, 1953]. 92p.

Extensive data are given relating properties of N-155 alloy under static, combined static and dynamic, and completely reversed dynamic stress conditions. Time periods for fracture ranged from 50 to 500 hr at room temperature, 1,000, 1,200, 1,350, and 1,500°F. The work was on a cooperative basis to help clarify the principles governing load-carrying ability of heat-resistant alloys at temperatures and conditions where both creep and fatigue can occur simultaneously. In view of the uncertainty in interpreting results of various types of fatigue tests, duplicate data were obtained from as many types of fatigue testing machines as could be arranged. (auth)

4171 NEI-22

Chalk River Project (Canada)

NOTES ON LIQUID METALS INFORMATION MEETING
[HELD AT GENERAL ELECTRIC LABORATORY,
SCHENECTADY, N. Y. ON] OCTOBER 8-10, 1952. H. E.
Tilbe and G. A. Wikhammer, comps. 19p.

4172 NP-5593

Battelle Memorial Inst.

THE EFFECT OF MICROSTRUCTURE ON THE MECHANICAL PROPERTIES OF TITANIUM ALLOYS. INTERIM REPORT NO. 6. MICROSTRUCTURE AND MECHANICAL PROPERTIES OF TITANIUM-IRON ALLOYS. F. C. Holden, H. R. Ogden, and R. I. Jaffee. Feb. 1, 1955. 42p. Contract DA-33-019-ORD-1397.

The properties of quenched Ti-Fe alloys were correlated with their microstructures. For specimens quenched from equilibrium in the alpha-beta field, the dominant microstructural variable is the alpha-beta ratio. In particular, the quantity and composition of the beta phase appear to govern the mechanical properties. This does not imply that other microstructural variables are not present and effective. For example, the presence of alpha as a fine dispersion or the formation of omega phase from beta has considerable influence on properties. Toughness, measured by the notched-bend impact test, is increased at room temperature and below by an increase in the amount of alpha phase in the specimen. This effect can be related to the transition behavior of the beta phase. A comparison of specimens having equiaxed alpha-beta microstructures with those having acicular alpha-beta structures shows that the equiaxed specimens have better tensile ductility, but lower impact resistance. There is evidence to show that specimens with acicular structures reach equilibrium in the alpha-beta field more rapidly than specimens with equiaxed structures. Beta phase can be retained on quenching at compositions as low as about 4% iron. The titanium-rich beta is very unstable, and is hardened considerably, probably by omega formation, during the quench. The stability of the beta phase is increased with alloy content. Aging at 400 C is effective in hardening the quenched Ti-7. 35Fe beta alloy. Eutectoid decomposition of beta was observed in specimens exposed at 550 C. For the 24-hour treatments used here, the amount of decomposition was too small to affect properties markedly. Plastic strain during this exposure did not

cause an increase in the amount of TiFe, and no further effect on mechanical properties was observed. (auth)

4173 NP-5597

North Carolina State Coll.

[HIGH TEMPERATURE MATERIALS]. VIBRATORY COMPACTING OF METAL AND CERAMIC POWDERS. QUARTERLY REPORT NO. 9 [COVERING THE PERIOD] JULY 1, 1954 TO OCTOBER 1, 1954. [William C. Bell and John R. Hart]. 32p. Contract AF 33(616)-73.

Investigation was made to establish the influence of particle size distribution on the thermal shock, impact, and transverse strength properties of three refractory compositions. The three compositions selected for this work are pure alumina, a 30 chromium-70 alumina composition, and a 15 nickel-85 titanium carbide composition. Test specimens are formed by vibratory compaction techniques. Representative equivalent compositions are to be formed by dry pressing and hydrostatic repressing for comparative purposes. Results of tests with a wide variety of particle size distributions are reported. Current data indicate that specimens containing substantial amounts of 100- and 28-mesh alumina can be made without seriously affecting the density or strength. Most of the work on the cermet compositions during this period has been concerned with standardizing the sintering procedure so that satisfactorily reproducible results can be obtained. Most of the work on carbide compositions during the period has been concerned with the establishment of optimum sintering procedures for all-fine carbide compositions. Both helium atmospheres and vacuum atmospheres have been investigated. Best results were obtained with vacuum atmospheres and relatively short sintering periods. Low absorption, high-density carbides were obtained. (auth)

4174 NP-5599

Metallurgical Advisory Committee on Titanium
PROCEEDINGS OF THE SYMPOSIUM ON MACHINING AND GRINDING OF TITANIUM HELD AT WATERTOWN ARSENAL, MARCH 31, 1953. 173p.

Various aspects of the problems encountered in the machining and grinding of titanium alloys are presented. Discussions on the influence of the following factors are included: cutting rate, temperature, chip formation, instrumentation, grinding wheel speed, grinding fluids, and grinding techniques. (C.W.H.)

4175 NP-5601

Mine Safety Appliances Co.

PROGRESS REPORT NO. 27 FOR FEBRUARY AND MARCH 1955. J. W. Mausteller, ed. Apr. 22, 1955. 62p. Contract NObs-65426.

Tests on the Mark B 3000-Kw steam generator are described, including a circulating cold trap and plugging indicator, system cleaning, pump performance, NaK furnace tube failure, boiler water analysis, and heat transfer. Engineering studies are summarized on vent and drain line closures, NaK cross flow exchanger, development of EM pumps, pressure gages, wetting with alkali liquid metals, thermal shock, bellows testing, valve cleaning and testing, and thermal insulation tests in liquid Na. The depression of Na₂O solubility in Na by K is discussed. Further studies on inhibition of mass transfer of radioactive stainless steel constituents in Na are described. The removal of residual radioactive Na with Na flushes was studied. Further results on radioactive leak contamination

and the reactions of molten Zr in water are reported. (For preceding period see NP-5536.) (L.M.T.)

4176 NP-5604

Battelle Memorial Inst.

THE EFFECT OF MICROSTRUCTURE ON THE MECHANICAL PROPERTIES OF TITANIUM ALLOYS. INTERIM REPORT NO. 5. PROPERTIES OF TITANIUM ALLOYS AS AFFECTED BY TEMPERATURE AND NOTCHES. H. R. Ogden, F. C. Holden, and R. I. Jaffee. Jan. 3, 1955. 42p. Contract DA-33-019-ORD-1397.

A study was made of the effect of notches and temperature on the tensile properties of five titanium-base alloys. These included two α alloys, two α - β alloys, and a β alloy. The tensile properties of the substitutional- α alloy were the least affected by changes in temperature or the introduction of a notch. The interstitial- α alloy had a sharp drop in unnotched reduction in area as the temperature was decreased from room temperature to -40 C; this is indicative of transition behavior. The presence of a notch resulted in less sharp transition behavior and raised the transition-temperature range. Changes in grain size of the Ti-Al alloy or grain shape in the Ti-N alloy had no significant effect on their temperature or notch dependency. Increasing the manganese content of α - β alloys causes an increase in the transition temperature of unnotched or notched samples. The presence of a notch reduces tensile ductility considerably and increases the transition temperature. In the acicular condition, the α - β alloys have low ductilities in unnotched tests. The alpha plates that are present act as internal notches and result in ductilities of the same order of magnitude as those of notched samples. The best condition for alpha-beta alloys is the equiaxed condition resulting from fabricating and annealing in the alpha-beta field. (auth)

4177 NP-5607

Battelle Memorial Inst.

THE EFFECT OF MICROSTRUCTURE ON THE MECHANICAL PROPERTIES OF TITANIUM ALLOYS. SUMMARY REPORT. F. C. Holden, H. R. Ogden, and R. I. Jaffee. Feb. 18, 1955. 20p. Contract DA-33-019-ORD-1397.

Alpha-stabilized alloys, in which alpha grain size and shape are the chief microstructural variables, show only slight response to heat treatment. Beta-stabilized alloys may be heat treated to produce a wider variation in microstructures and mechanical properties. Alpha-beta ratio generally determines the mechanical properties of alloys annealed in the alpha-beta field. In addition, alpha-beta grain shape (equiaxed or acicular) affects mechanical properties. An important finding is that alpha-beta equilibrium is reached more quickly when the alloy is initially heated into the beta field. The transformation kinetics in a beta-stabilized-alloy system having an active eutectoid can be described by nucleation and growth processes. (auth)

4178 NP-5611

Minerals Research Lab., Inst. of Engineering Research, Univ. of Calif., Berkeley

STUDY OF ENERGY OF ATOMIC BONDING FORCES IN ALLOYS. TECHNICAL REPORT NO. 1 [FOR] PERIOD DECEMBER 21, 1953 TO JANUARY 31, 1955. THE APPLICATION OF LIQUID TIN SOLUTION CALORIMETRY TO THE STUDY OF ATOMIC BONDING FORCES IN ALLOYS. Raymond Orr, Alfred Goldberg, and Ralph Hultgren. Mar. 1, 1955. 87p. Contract DA-04-200-ORD-171, T. O. 8.

The design, development, and operation of a liquid-tin solution calorimeter are described. Preliminary results are presented for the heats of solution of Ag, Au, Cd, and Cd-Ag in liquid Sn and for the heats of formation of a series of Ag-Cd alloys. (auth)

4179 NP-5614

Mine Safety Appliances Co.

LIQUID METAL TECHNOLOGY. FINAL REPORT.

(A review of the work from May 1949 to May 1954 with abstracts of reports issued). R. C. Werner. Mar. 29, 1955. 77p. Contract N9onr-85801.

A final summary is presented of the various activities which have been carried out on liquid Na and NaK plumbing systems. Results on heat transfer, flow properties, corrosion tests, accessibility, Na cleaning, and tests on valves, bellows, pumps, etc. are included. Approximately half of the report consists of abstracts of the various technical reports and memos which have been issued under the contract. (For preceding progress report see NP-5601.) (L.M.T.)

4180 RDB-(C)/TN-86

Culcheth Labs., Research and Development Branch, Dept. of Atomic Energy (England)

THE HYDROGEN REDUCTION OF MOLYBDENUM OXIDES. A PRELIMINARY INVESTIGATION. W. E. Dennis and R. Wardle. July 27, 1954. 18p.

A method has been developed for the reduction of compacts of MoO_3 to metal compacts suitable for arc melting. This will permit reduced metal to be charged into an arc furnace via a drybox without further treatment. It has been shown that the particle size and shape of the molybdenum metal varies considerably with the reduction conditions used. (auth)

4181 RDB(C)/TN-117

Culcheth Labs., Research and Development Branch, Industrial Group, United Kingdom Atomic Energy Authority (England)

THE METALLIC REDUCTION OF VANADIUM OXIDES. W. E. Dennis and A. F. Adamson. Mar. 28, 1955. 26p.

A method of producing vanadium in massive form by the calcium reduction of V_2O_5 in a bomb, using sulphur as a thermal booster, has been developed. Ductile metal has been obtained by the reduction of both technical and reagent grade oxide with either high purity calcium, or ordinary calcium when an addition of zirconium is made as zirconia to the charge. It has not yet, however, been proven that it is essential to make a zirconium addition when using ordinary calcium. (auth)

4182 WADC-TR-53-502

Horizons, Inc.

ROLL CLADDING OF BASE METALS WITH TITANIUM.

Peter F. Matalch and F. Clifton Wagner. Dec. 1953. 35p. Contract AF33(616)-393. (AD-29400)

A study of the roll cladding of Ti to steel was conducted using an intermediate layer of Cr, Co, Fe, Mo, or Ni as bonding agent. Cr appears to be the best bonding agent. (C.W.H.)

4183 WADC-TR-53-503

Horizons, Inc.

[CLADDING OF BASE METALS WITH TITANIUM].

ELECTRODEPOSITION OF TITANIUM ON BASE METALS. Merle E. Sibert. Dec. 1953. 33p. Contract AF33(616)-393. (AD-37702)

An electrolytic method has been developed for cladding of base metals with Ti. The procedure entails a fused salt electrolysis under a protective inert atmosphere. Completely corrosion-resistant coatings have been produced on a variety of simple geometric shapes. Work was also presented on the development of a fused salt electroplating process. (auth)

4184 WADC-TR-54-40

California Univ., Berkeley

THE EFFECT OF GRAIN SIZE ON THE FATIGUE AND CREEP PROPERTIES OF STAINLESS STEEL AND INCONEL AT ELEVATED TEMPERATURES. A. T. Robinson and J. E. Dorn. Apr. 1954. 37p. Contract AF33-(038)-22608. (AD-38231)

An investigation was undertaken to evaluate the effect of grain size, as produced by annealing, on the high-temperature creep and fatigue properties of Inconel and an 18-8 stainless steel. In order to isolate the effects of grain size and annealing from other metallurgical effects, an attempt was made to select materials which were not particularly prone to extraneous changes such as precipitation or spheroidization of intermediate phases. But, in order to estimate the practical utility of practicing annealing for grain size control of high-temperature alloys, the two representative alloys Inconel and type 304 extra low carbon 18-8 stainless steel were chosen. Unfortunately both of these materials were found to exhibit structural changes during annealing which might have affected their creep and fatigue properties. The results indicate that to clearly delineate the effect of grain size on the properties of metals it will be necessary to use metals in which all auxiliary microstructural changes are absent. (auth)

4185 WADC-TR-54-120

[Engineering Research Inst.], Univ. of Mich.

AN INVESTIGATION OF INTERGRANULAR OXIDATION IN STAINLESS STEEL. Clarence A. Siebert, Maurice J. Sinnott, and Robert E. Keith. Sept. 1954. 138p. Contract AF-33(616)-353.

Specimens from one heat of type 309-Nb and eight heats of type 310 stainless steel were oxidized in dry, moving air for times up to 100 hr in the temperature range 1600 to 2000°F. Intergranular oxidation severity measurements were made microscopically. X-ray powder patterns were made of representative scales. Visual and magnetic examinations were made of both the specimens and the oxide scales. No appreciable difference in the severity of intergranular oxidation was observed that could be attributed to differences in alloy content among the heats. In general, intergranular penetration increased with time and temperature. X-ray analysis showed Cr_2O_3 , $\text{Cr}_2\text{O}_3\text{-Fe}_2\text{O}_3$ solid solutions, Fe_2O_3 , and a high-parameter spinel phase in the scales. All of the scales examined were protective in nature, and no improvement in penetration characteristics is foreseen by making minor changes in alloy contents. (auth)

4186 WADC-TR-54-280

New York Univ.

[TITANIUM METAL AND ALLOY]. A METHOD FOR RETAINING BETA PHASE IN THE CORE OF PLATES AND RODS OF TITANIUM ALLOYS. P. Herasymenko and J. Winter. Nov. 1954. 59p. Contract AF 33(616)-2259.

Twelve 1-kg ingots were prepared having the following nominal compositions: Ti-(6, 8, 10, 12%) Cr, Ti-3%Al-(6, 8, 10%) Cr, and Ti-(6, 9, 12%) Mn. The ingots were

forged to $\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. square bars, which were heat treated using two-step quenching. Microstructures and hardness on the cross section of bars were investigated. Evidence is presented that soft beta can be retained in the center of bars and plates by step-quenching in alloys containing 12% Cr in the Ti-Cr series, 10% Cr in the Ti-3%Al-Cr series, and 12% Mn in the Ti-Mn series. The outer layers of bars are considerably harder than the core after step-quenching. (auth)

4187 WAL-401/214-2

New York Univ. Coll. of Engineering

TITANIUM PHASE DIAGRAM STUDY. FINAL REPORT. P. Farrar, W. Kirk, and L. Stone. Sept. 30, 1954. 120p. Contract DA-30-069-ORD-1216.

A study of the Ti-rich corner of the ternary systems, Cr-Ti-V, C-Si-Ti, and H-N-Ti is presented. Figures and tables pertaining to the phase studies of the systems are tabulated. (J.E.D.)

4188 WAL-801/6-25

Institute of Research, Lehigh Univ.

TEMPER BRITTLINESS IN STEELS. ISOTHERMAL EMBRITTLEMENT IN COMMERCIAL NICKEL, CHROMIUM, NICKEL-CHROMIUM AND MOLYBDENUM ALLOY STEELS DURING TEMPERING. U. G. Bhat. May 28, 1954. 50p. Contract DA-36-034-ORD-1083. Final Report. (AD-37321)

Transition temperature data are presented to show the development of embrittlement in commercial nickel (AISI 2340), chromium (AISI 5140), nickel-chromium (AISI 3140), and molybdenum (AISI 4047) alloy steels, reheated to 800 to 1260°F after hardening and tempering to establish an essentially unembrittled state. The influence of temperature and time upon the progress of embrittlement is given by iso-embrittlement diagrams for all steels. The embrittling characteristic of the chromium, nickel and nickel-chromium are strikingly different from those exhibited by a plain carbon steel. Two distinct regions of embrittlement are apparent at 800 to 1000°F and in the temperature range just below the lower critical. The pronounced embrittlement at 800 to 1000°F decreases very rapidly with increasing temperature, only to increase again as the lower critical temperature is approached. At extended embrittling times, the course of embrittlement at temperature of 1100 to 1150°F may be influenced by the superposition of high and low temperature embrittlement. Embrittlement in the molybdenum alloy steel generally increases with time and temperature to the lower critical in the same manner as plain carbon steel. While the molybdenum steel shows little susceptibility to embrittlement at 800 to 1000°F, considerable embrittlement may occur just below the lower critical temperature. The data suggest the possibility of two distinct modes of embrittlement in alloy steels. (auth)

4189 AEC-tr-2120

ON THE SUITABILITY OF ELECTROLYTICALLY POLISHED SPECIMENS FOR THE METALLOGRAPHIC INVESTIGATION OF ALUMINUM AND ITS ALLOYS. (Über Die Eignung Elektrolytisch Polierter Prober Für Die Metallographische Untersuchung Von Aluminium Und Seinen Legierungen). H. Röhrig and W. Schneider. Translated by Mary L. Mahler from *Aluminium* 23, 281-4(1941). 10p.

Results of the electrolytic polishing of several samples of Al and Al alloys are presented. It appears that this method will have limited practical application. (C.W.H.)

4190 AEC-tr-2128**FUNDAMENTALS OF THE THEORY OF EXTRUSION.**

F. Gatto. Translated by E. U. Kauer from Alluminio 23, 533-45(1954). 24p.

Problems associated with the theory of extrusion are outlined. For the mathematical solution of these problems two methods (static equilibrium and plasticity) are presented. The calculated results are compared with experimental data. (C.W.H.)

4191 AERE-Lib/Trans-468**A CONTRIBUTION ON THE EXPLANATION OF THE****DIFFUSION PROCESSES IN THE COPPER-NICKEL SYS-**

TEM. Wolfgang Seith and Rudolf Ludwig. Translated by R. J. Richardson from Z. Metallkunde 45, 401-7(1954) 11p.

The concepts of vacancy formation, vacancy annihilation, and partial mass flow are discussed. Microscopic techniques are used in the experimental phase of the work. (C.W.H.)

4192 AERE-Lib/Trans-500**MAGNETIC SUSCEPTIBILITY AND CHANGE OF STATE ON****TEMPERING ALUMINUM-COPPER ALLOYS.** H. Auer.

Translated by J. B. Sykes from Z. Metallkunde 28, 164-75(1936) 25p.

An evaluation and interpretation of susceptibility measurements on temperable, paramagnetic alloys in both homogeneous and heterogeneous limiting states and of the change of state which takes place on tempering are presented. (C.W.H.)

4193 AERE-Trans-11/3/5/253**INVESTIGATIONS ON POWER REQUIREMENTS IN EXTRU-****SION AND PUNCHING.** Erich Siebel and Erich Fangmeier.

Translated from Mitt. Kaiser-Wilhelm-Inst. Eisenforsch.

Dusseldorf 13, 29-41(1931). 27p. (AD-45943)

4194**FUSED-IN-PLACE SPRAY METALLIZED COATINGS.**

Sam Tour (Sam Tour & Co., Inc., New York). Welding J. (N. Y.) 34, 329-36(1955) Apr.

Methods of metallizing and fusing, metallurgical nature, and service applications are given for several fused-in-place spray metallized coatings. (auth)

4195**PLASTIC FATIGUE PROPERTIES OF HIGH-STRENGTH****PRESSURE-VESSEL STEELS.** J. H. Gross and R. D.

Stout (Lehigh Univ., Bethlehem, Penna.). Welding J.

(N. Y.) 34, 161s-6s(1955) Apr.

This is the fourth of a series of papers covering a study of the resistance of steels applicable to pressure vessels to repeated loading in the plastic range (see also Welding J. 31(5), 32(1), and 33(1)). Fatigue test results are reported for the following steels: A-201, A-225, 48s5, Fortiweld, A-302, 70A, 70B, 90A, and 90B. (L.M.T.)

4196**STUDIES ON THE BIAXIAL FATIGUE PROPERTIES OF****PRESSURE VESSEL STEELS.** J. T. Tucker, Jr.

(Babcock and Wilcox Co. Research Center, Alliance, Ohio).

Welding J. (N. Y.) 34, 179s-82s(1955) Apr.

Bowman and Dolan (Welding J. 34, 51s-59s(1955))

presented data and interpretation of the data on high-strain-range fatigue of high-strength steels, making comparison with some of the more conventional steels used in the manufacture of pressure vessels. In this paper the author adds a discussion to Bowman and Dolan's paper to include some additional data to supplement those already presented,

and to show a comparison of biaxial with uniaxial data. (L.M.T.)

4197**AN INVESTIGATION OF THE HOT DUCTILITY OF HIGH****TEMPERATURE ALLOYS.** E. F. Nippes, W. F. Savage,

B. J. Bastian, and H. F. Mason (Rensselaer Polytechnic

Inst., Troy, N. Y.) and R. M. Curran (General Electric Co.,

Schenectady, N. Y.). Welding J. (N. Y.) 34, 183s-96s

(1955) Apr.

The details of construction of a device for determining the effects of testing temperature and prior thermal history on the hot ductility of structural alloys are summarized. The device permits subjecting suitable samples to the actual thermal cycles experienced in the heat-affected zone of an arc weld made in the alloy under study, and evaluating the influence of these thermal cycles on the hot ductility of the material. Two grades of stainless steel, a cast and heat-treated Type 316 modified with columbium and a wrought Type 347 stainless steel have been subjected to such tests. The results indicate a significant difference in the hot ductility of these materials. Furthermore, tests show that brief exposure to temperatures in the vicinity of 2400°F, such as would be found in the region immediately adjacent to the fusion zone of an arc weld, severely reduce the hot ductility in both grades. It is believed that the reduction in hot ductility and the incidence of cracking in the heat-affected zone are intimately related. (auth)

4198**WELDING PROCEDURE QUALIFICATION TESTS FOR****SIX HIGH-YIELD-STRENGTH STEELS.** A. P. Bunk

(Chicago Bridge & Iron Co.). Welding J. (N. Y.) 34,

197s-206s(1955) Apr.

Welding procedure qualification tests, made in accordance with Section IX of the ASME Code for Unfired Pressure Vessels, were conducted on three pairs of steels with minimum yield strength of 50,000, 70,000 and 90,000 psi, respectively. The purpose was to establish suitable welding procedures which would meet the requirements of the Code. The more important results of this study are summarized. (auth)

4199**ON THE PRIMARY CRYSTALLIZATION OF THE SYSTEM**

Sn-Bi. Tadashi Yanagihara and Rokuro Kawanishi.

Science Repts. Tohoku Univ. Ser. A 6, 557-64(1954) Dec.

The viscosity change during the solidification of the alloy Sn-Bi was studied with the rotational viscosimeter. The size of the primary crystal was also microscopically examined. It was found that the primary crystals were apt to solidify in small sizes, as the composition of the alloy approached the eutectic, or when the temperature at which the alloy was kept became low. (auth)

4200**NONFERROUS METALLURGY.** M. L. Moss (Aluminum Co.

of America, New Kensington, Penna.). Anal. Chem. 27,

614-23(1955) Apr.

A review of literature published on nonferrous metallurgical analysis for the period 1952 to 1954 is presented. A large number of references are concerned with Al, Be, U, Ti, and Zr. 201 references. (C.W.H.)

4201**RESEARCH ON THE DISSOCIATION OF TITANIUM OXIDE****AND ON ITS REDUCTION BY CARBON MONOXIDE.** Pierre

Assayag, Maurice Dode, and Rene Faivre. Compt. rend. 240, 1212-14(1955) Mar. 14. (In French)

4202

TITANIUM REFERENCE SHEET. PART 2. G. E. Hutchinson (Rem-Cru Titanium, Inc., Midland, Penna.). Chem. Eng. Progr. 51, 38(1955) Apr.

The corrosion rates of titanium and its alloys in various commercial chemicals are outlined. Possible commercial applications of the titanium alloys are mentioned. (C.W.H.)

4203

USE OF CARBON ISOTOPE C^{14} FOR INVESTIGATION OF THE DIFFUSION OF CARBON IN STEEL. P. L. Gruzin, V. G. Kostogonov, and P. A. Platonov (Inst. of Metallography and Physics of Metals, Central Research Inst. of Ferrous Metallurgy). Doklady Akad. Nauk S.S.S.R. 100 1069-72 (1955) Feb. 21. (In Russian)

PHYSICS

4204 AD-28528

Bartol Research Foundation, Franklin Inst. SEMI-ANNUAL REPORT [FOR] JULY 1, 1953-DECEMBER 31, 1953. C. E. Mandeville. Feb. 15, 1954. (Includes three reprints). 59p. Contract Nonr436(00).

Pulse-height distribution curves were obtained when an Ni scatterer, constructed of Ni shot which was poured into a thin-walled doughnut of tin, was irradiated by 3.8-Mev neutrons; a peak appeared at about 1.36 Mev. Studies of the radioactive decay of Co^{60} indicated that the spins of the levels of Ni^{60} followed the pattern of the even-even nuclei (4-2-0) so that 4 units of angular momentum were necessary for excitation of the 2.52-Mev level. Data obtained on the pulse-height distribution which resulted from the scattering of 3.8-Mev neutrons by Cu indicated the presence of a 0.9-Mev γ ray plus unresolved γ -rays of higher energy. A distribution curve which is given for the 3.8-Mev irradiation of a Zr scatterer indicates the presence of γ rays with energies of 0.9, 2.2, and possibly 1.15 Mev. The differential cross sections for the scattering of 3.7-Mev neutrons from Cd, Sn, and Bi were measured in order to establish the variation pattern with at. wt. The recent continuum theory of nuclear reactions (Phys. Rev. 90,116 (1953)) was used, with a plausible extension, to calculate the angular distribution of 3.7-Mev neutrons scattered from nuclei of 115 and 209 at.wt. An ion source providing larger beam currents was incorporated in the LV accelerator; a 120- μ a beam was focused on a 1.5-in.-diam. target at a 10-ft distance from the source. An abstract is included for research on the inelastic scattering of neutrons by Ba^{137} and Hg^{199} . (For preceding period see AD-16225.) (ASTIA abstr.)

4205 AECU-3021

Laboratory for Nuclear Science, Mass. Inst. of Tech. PROGRESS REPORT [NO. 36 FOR NOVEMBER 30, 1954 THROUGH FEBRUARY 28, 1955]. Feb. 28, 1955. 71p. Contract AT(30-1)-905 and N5ori-07806.

Nuclear Chemistry. Spectrophotometric studies have been continued on the bromide complexing of In in aqueous solution and on the autoreduction of the ferric thioglycolate complex formed in alkaline media. The Mn contents of beef liver and spleen, chicken liver, and a bacterial culture have been determined by activation analysis. Studies on the ex-

traction of Ga(III) from aqueous HCl by organic solvents have been extended to diisopropyl and dihexyl ether. The half lives of Rh^{105} and Rh^{107} have been determined in connection with a study of thermal neutron U^{235} fission yields in the valley region. The tritium isotope effect in the enolization of ketones has been determined for hydronium ion catalysis. It has been found that a cyclohexane solution of benzoyl probably gives no more than 4% phenyl benzoate in a cage reaction. Cosmic Rays. Analysis of multiplate cloud chamber records indicates that S events represent decay processes of 2 kinds of particles: $K_{\pi 2} \rightarrow \pi^+ + \pi^0$ and $K_{\mu 2} \rightarrow \mu + \nu$. A method has been developed for utilizing the observed change in ionization of a particle traversing a multiplate cloud chamber to give a more accurate value for that particle's range. Elementary Particle Scattering. Analysis of photon scattering data between 0.6 and 3.25 Mev has been completed. The measured elastic differential scattering cross sections per atom for Cu, Cd, In, and Pb are plotted as a function of photon energy. Neutron Physics. The excitation functions and cross sections for the production of low energy γ rays following the inelastic scattering of neutrons have been measured for Mn, I, Au, Pt, Re, W, Ta, and Hf. Energy levels in enriched isotopes of Cd and Pd and in natural Mo have been studied by electric excitation with protons. The γ -ray pulse height spectra, electric excitation cross sections, and electric quadrupole transition probabilities are given. ONR Generator. Angular distribution measurements on $N^{14}(d,p)N^{15}$ have been carried out with a broad-range spectrograph. Energy levels of Na^{22} are being studied. Preliminary values for excitation energies for 6 excited states have been obtained using (p, α) and (d, α) reactions. Preliminary results are reported for energy level determinations in $Cl^{35}(d,p)Cl^{36}$ and $Cl^{35}(d,\alpha)S^{33}$ reactions and for angular distributions of Ca(d,p) reactions. Theoretical Group. Studies are continuing on the Bohr-Mottelson nuclear model, the imaginary potential within the nucleus required in the optical model, calculation of differential cross sections for proton bremsstrahlung, and internal pair production accompanying β transitions of nuclei. (For preceding period see AECU-2991.) (M.P.G.)

4206 AERE-GP/R-1578

Atomic Energy Research Establishment, Harwell, Berks (England) A MATRIX TREATMENT OF FOUR-ARM BRIDGES. L. B. Mullett. Jan. 6, 1955. 10p.

A matrix method of analyzing a four-arm bridge circuit is developed. A particular type of bridge is chosen as an example. The natural development of conjugate conditions from symmetry and matching operations is shown. The final four by four matrix appears in the universal form which can be obtained from an unknown box with four sets of terminals where the only properties assumed are conjugacy and correct power addition or division. The treatment is one which is applicable to a wide range of ring circuits. (auth)

4207 BNL-2294

Brookhaven National Lab. A PRECISION HIGH VOLTAGE ATTENUATOR WITH GOOD FREQUENCY RESPONSE. J. G. Cottingham. [Mar. 28, 1955]. 10p.

An attenuator for 30 kv with frequency response up to 200 kc is described, and methods are described for compensating the stray capacities to ground. (L.M.T.)

4208 NP-5578

California Inst. of Tech.

AUXILIARY EQUIPMENT FOR CIT ROTATING MIRROR CAMERA AND FURTHER NOTES ON THE CAMERA. I. S. Bowen. June 8, 1945. 18p. Contract OEMsr-418. (K-3.3)

Auxiliary equipment, design modifications, and the operation of the CIT rotating mirror camera are discussed. (cf. AECD-3028.) (C.H.)

4209 NP-5594

Laboratory for Magnetics Research, Carnegie Inst. of Tech.

THE MAGNETIZATION OF SOME ALLOYS OF NICKEL AND THE COLLECTIVE ELECTRON THEORY OF FERROMAGNETISM (thesis). TECHNICAL REPORT NO. 3. A. Arrott. May 1954. 115p. Contracts N7onr30307 and Nonr633(00).

An investigation of the magnetic properties of Cu-Ni and Cr-Ni alloys and their relation to the 3d band has been carried out. Measurements of magnetization at temperatures between room temperature and liquid He temperatures have been made for a range of compositions near that for which ferromagnetism vanishes. A new technique for measuring magnetizations at these temperatures is described. The method makes use of the fact that the magnetization of a cylindrical sample placed in a uniform field may be completely cancelled out by a current passing through a small pitch solenoid wound on the surface of the sample. A theoretical model, based on the collective electron approach, of the Cu-Ni system is analyzed with particular emphasis placed on the spontaneous magnetization at 0°K, the Curie temperature, and the electronic specific heat, all as a function of the composition of the alloys. With the simplest possible assumptions this model gives a consistent account of the thermal and magnetic properties of the ferromagnetic Cu-Ni alloys by employing a rectangular density of states curve for the 3d band. Measurements of magnetization of Cu-Ni alloys of 58 and 63 at.% Cu and of Cr-Ni alloys of 15 and 20 at.% Cr are reported. The results of our measurements on Cu-Ni alloys support the theoretical model presented here. The Cr-Ni data give added information concerning the transition from ferromagnetism to nonferromagnetism in solid solutions. Measurements of the susceptibility of V at liquid He temperatures show that a reported anomaly in the specific heat of this metal is the result of measurements in magnetic fields too low to quench the superconductivity. (auth)

4210 NP-5616

Research Lab. of Electronics, Mass. Inst. of Tech.

QUARTERLY PROGRESS REPORT [NO. 36 FOR THE PERIOD ENDING NOVEMBER 30, 1954]. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann. Jan. 15, 1955. 127p.

A vacuum tube electrometer for a vacuum ionization gage is described, and a circuit diagram is given. Preliminary experiments have shown that plasma resonance has a pronounced effect on the transmission of microwaves through plasma. The collision probability of slow electrons in Ne and electrical breakdown in Ge are being studied by microwave techniques. An expression is derived for the minimum noise figure of longitudinal beam amplifiers. Other topics covered include communication theory, semiconductors, and analog computer research. (For preceding period see NP-5427.) (M.P.G.)

4211 PIBAL-216

Polytechnic Inst. of Brooklyn

BIBLIOGRAPHY ON THERMAL ELASTICITY. William I. Berks and Alexander Chwick, comps. Jan. 1953. 43p. Contract AF33(616)-116. (AD-36788)

4212 UCRL-2930

Radiation Lab., Univ. of Calif., Berkeley

HIGH PRESSURE LOW RESISTANCE JOINT. Ralph Peters. Mar. 28, 1955. 3p. Contract W-7405-eng-48.

The problem of obtaining a mechanical joint of low electrical resistance and at the same time providing a seal to hold water at a pressure of 300 psi was solved by the use of a gasket made of foil of pure tin. The foil is inserted between copper blocks where the electrical and hydrostatic joint is wanted. The faces pressing against the foil can be perfectly smooth but the joint is made more reliable and requires less clamping pressure if one of the faces is serrated with circular grooves. Sixty-degree V grooves, spaced 0.025-in. apart and 0.012-in. deep, work well, although these dimensions are not critical. The foil used is 0.005-in. thick. The average resistance of a number of joints tested was 3 micro-ohms. (auth)

4213 AEC-tr-2122

THE ENERGY SPECTRUM OF CANAL-RAY IONS. K.

Deutscher and D. Kamke. Translated from *Z. Physik* 135, 380-94(1953). 12p. Available from Associated Technical Services (Trans. 49G5G), East Orange, N. J.

Immediately behind the cathode of a canal-ray discharge (in H₂, He, A, O₂), the widths of the ion bundles are measured for different ion energies by means of a movable deflecting condenser. The width is found to depend on the ion energy and in its over-all characteristics on the shape of the electrodes. By means of the distributions of the radial ion current for different energies, the energy spectrum of the entire ion ray is determined. This total spectrum is in agreement with the one calculated on the basis of a theory of canal-ray discharges. (auth)

4214 AERE-Lib/Trans-472

ACTIVITIES IN THE CASE OF DIFFUSION IN TERNARY METALLIC SYSTEMS. W. Seith and H. Wever. Translated by F. Hudswell from *Z. Electrochem.* 55, 380-4(1951). 7p.

In diffusion experiments in ternary metallic systems, it has been observed that the concentration plot of the individual component after diffusion has taken place exhibits discontinuities. The plots of the corresponding curves in which concentration is replaced by activity are smooth. Measurements on the diffusion of carbon from a C-Fe system into an Fe-Si system, for which measured values of activity were available, confirmed the results previously deduced. (M.P.G.)

AEROSOLS**4215 AD-9065**

Southern Research Inst.

DEVELOPMENT OF A PARTICLE COUNTER. FINAL REPORT. A. L. Thomas, Jr. Jan. 15, 1953. 32p. Contract DA-18-064-cml-2101.

By refining the control of light and aerosol in a new particle counter, an instrument has been developed which will indicate the diameter of spherical particles within one-half micron. The range of particle size for which calibration is known is 0.3 to 2.0 microns diameter of DOP, and as many as 75×10^3 particles may be measured per minute. Completely independent mounting of each com-

ponent in the instrument simplifies adjustment and modification of the optical system. Instead of the usual way of sealing optical parts together to form the enclosure for the aerosol flow stream, an over-all cover was provided. When the cover is removed, all parts and services remain in operating condition. A method for checking sensitivity of the photometer has been devised in which a heavy gas is passed through the sensitive volume. The scattered light received by the phototube increases in relation to the ratio of the size of the molecules of the gas to those of air. (auth)

4216 BNL-2242

Brookhaven National Lab.

ATMOSPHERIC DIFFUSION FORMULAE AND PRACTICAL POLLUTION PROBLEMS. Maynard E. Smith. Mar. 2, 1955. 14p.

COSMIC RADIATION

4217

LATITUDE EFFECT OF COSMIC RADIATION AT LOW ALTITUDES. Martin A. Pomerantz (Franklin Inst., Swarthmore, Penna.). *Phys. Rev.* **98**, 105-6(1955) Apr. 1.

The latitude effect, $L = 1 - [N(\lambda_2)/N(\lambda_1)]$, where $N(\lambda_1)$ is the intensity at $\lambda_1 > 40^\circ$ and $N(\lambda_2)$ is the intensity at low latitude λ_2 , has been determined on the basis of absolute flux measurements at two ground stations in India. Near sea level, $L = 8.8 \pm 0.6\%$ ($\lambda_2 = 18^\circ$ N). At an atmospheric depth of 770 g cm^{-2} , $L = 13.1 \pm 0.6\%$ ($\lambda_2 = 23^\circ$ N). At low altitudes (up to 30,000 ft) the latitude effect with respect to the geomagnetic equator in Peru is equal to that with reference to 18° N in India as expected on account of the eccentricity of the terrestrial dipole. (auth)

4218

RECURRENCE PHENOMENON IN THE 24-HOUR VARIATION OF COSMIC-RAY INTENSITY. R. P. Kane (Univ. of Chicago, Ill.). *Phys. Rev.* **98**, 130-5(1955) Apr. 1.

Changes of cosmic-ray intensity in 24-hour intervals were studied at four neutron monitor stations and for one ionization chamber in the geomagnetic latitude range 0° to 52° N. There is evidence that the fluctuations in the 24-hour variation of cosmic-ray intensity have a recurrence tendency of 27 to 28 days. There does not appear to be, however, any unique relationship between this recurrence and the well-known recurrence in the amplitude of the mean daily intensity. The association of this phenomenon with 27-day recurring disturbances in the geomagnetic field is also investigated. (auth)

4219

MASS SPECTRUM OF SHOWER PARTICLES FROM COSMIC-RAY INTERACTIONS. A Husain and E. Pickup (National Research Council, Ottawa, Canada). *Phys. Rev.* **98**, 136-9(1955) Apr. 1.

The masses of particles with an ionization less than about twice the minimum value emitted in cosmic-ray stars in a photographic emulsion have been determined by observations on the grain density and scattering of suitably long tracks. About 100 tracks with an average length of 16.5 mm were analyzed using a single emulsion exposed to cosmic rays in a high-altitude balloon flight of nine hours duration. The results show groups of pions, protons, deuterons, heavy mesons with mass $\sim 925m_e$, and the possibility of a group with mass closer to that of the proton. This latter is uncertain, however, with the present resolution and could be a statistical fluctuation on the edge of the proton distribution. (auth)

4220

MESONIC DECAY OF AN EJECTED TRITON. Herman Yagoda (National Institutes of Health, Bethesda, Md.). *Phys. Rev.* **98**, 153-7(1955) Apr. 1.

A heavy fragment is ejected from a star of type $21+5p$ which decays at rest into three charged particles. Gap counts indicate that the ejected fragment is singly charged and heavier than a proton. The mass of the particle, as estimated by constant sagitta scattering along its range of 1330 microns, is 2.93 ± 1.36 proton masses. All three secondary particles terminate their range, and one of them can be identified as a negative pi meson of 26.6 ± 0.9 Mev kinetic energy. Two short recoil tracks, if assumed to be protons, have kinetic energies of 1.43 ± 0.04 and 2.31 ± 0.15 Mev, respectively. Momentum balance applied to several decay schemes suggest that the event probably represents $H^3 \rightarrow H^1 + H^1 + n^0 + \pi^- + Q = 31.5 \pm 1$ Mev. The binding energy of the excited triton is found to be 5.4 ± 1 Mev, less than that of the normal triton (8.48 Mev). The time of flight of the excited triton is 4.2×10^{-11} sec. (auth)

4221

SCINTILLATION COUNTER STUDY OF ENERGY SPECTRA OF COSMIC-RAY PHOTONS AND ELECTRONS AT 11,200 FEET. C. N. Chou and Marcel Schein (Univ. of Chicago, Ill.). *Phys. Rev.* **98**, 162-4(1955) Apr. 1.

An apparatus designed to measure cascade showers initiated by photons and electrons of energies in the range of 1 to 30 Bev was used to measure the energy spectra of cosmic-ray photons and electrons at Climax, Colorado (altitude 11,200 feet). The apparatus consisted of four anthracene-in-polystyrene plastic scintillators, interposed with 2.00 cm, 2.25 cm, and 2.25 cm of lead plates, respectively. Four trays of G-M counters and a set of anticoincidence G-M counters were used simultaneously with the scintillators. More than 10,000 events were recorded and analyzed. The results show that in the energy range of 2 to 20 Bev, the integral energy distributions can be represented by a power law expression of the form $N(>E) = \text{const } E^{-s}$, with s equal to 1.6 ± 0.2 for the photon component and s equal to 1.5 ± 0.2 for the electron component. (auth)

4222

MORE PRECISE EQUATIONS FOR DIFFUSION OF COSMIC PROTONS IN INTERSTELLAR MEDIUM. Ya. P. Terletskii (Moscow State Univ.). *Doklady Akad. Nauk S.S.S.R.* **101**, 59-62(1955) Mar. 1. (In Russian)

4223

THE LATERAL DISTRIBUTION OF VARIOUS COMPONENTS IN EXTENSIVE AIR SHOWERS AT SEA LEVEL. Goro Fujioka (Kobe Univ., Japan). *J. Phys. Soc. Japan* **10**, 245-9 (1955) Apr.

The lateral distribution of electrons, μ mesons, and N components is observed at sea level up to 50 m from the core. The distribution of electrons is consistent with that calculated on the basis of cascade theory. The distribution of μ mesons is flatter than that of electrons and is represented as $r^{-0.7}$. The distribution of N components is similar to that of electrons. The number of μ mesons is equal to that of N components at several meters from the core. (auth)

ELECTRICAL DISCHARGE

4224 AEC-tr-2124

A STUDY OF THE PLASMA FROM A HIGH-POWER ARC. Richard Weiss. Translated from *Z. Physik* **138**, 170-

954). 10p. Available from Associated Technical Services (Trans. 48G5G), East Orange, N. J.

Two types of water-stabilized high-power arcs are described, for which the plasma, which emerges through a ring-shaped electrode, can be readily studied. For the following experimental conditions, a plasma with a maximum length of 4 cm is obtained: arc length, 5 cm; canal [channel] diameter, 7 mm; arc current, 150 amp. High-speed photographs show a secondary arc outside the arc column, produced by electrical coupling between the plasma and the ring electrode. However, a "dead" plasma is obtained 5 sec after striking the arc. Simple criteria for the absence of current are given. The temperature distribution, degree of ionization, and axial flow rate of the plasma are measured. It is shown that the steady-state energy content per cubic centimeter of the arc column is independent of canal cross section and of current density, as well as essentially insensitive to the radial temperature distribution in the arc and is always of the same order of magnitude. The effect of the magnetic field on the plasma is investigated. (auth)

4225 AERE-Lib/Trans-462
PLASMA AND THE LANGMUIR SHEATH—ON THE THEORY OF ELECTRICAL PROBES IN GAS DISCHARGES. F. Wenzl. Translated by F. Hudswell from *Z. angew. Phys.* 2, 59-75(1950) 36p.

Certain simplifying assumptions in the Langmuir theory of electrical probes in gas discharges lead in many cases to fundamentally incorrect values for the mean kinetic energy (the temperature) of the ions in the discharge. On the other hand, the usual measurement of the temperature of the electrons is not, on the whole, affected by these simplifications, and that of the charge density and of the plasma potential are similarly affected only a little. A more accurate investigation of the position of negative saturation current in spherical probes facilitates an insight into the field distribution and the concentration of the sheath charge density even outside the true "Langmuir Sheath" around the probe, with the provision that the thickness of this layer at its maximum is about equal to the radius of the probe, and that the latter is small compared with the free path in the discharge. The corresponding properties are also treated for cylindrical probes. With the aid of this, disagreements between theory and experiment with respect to the electrical probe are clarified. At the same time some general formulations are obtained for the transition from plasma to the Langmuir Sheath. (auth)

INSTRUMENTS

4226 AD-30491
Ohmart Corp.
STUDY AND DEVELOPMENT OF NUCLEAR BATTERIES. [Philip E. Ohmart]. [1954]. 17p. Contract AF33(616)-172, Phase Scientific Report No. 1.

Nine nuclear cells were constructed with electrode combinations of Cd and Au, Mg and Au, Al and Au, and Al and PbO₂. Temperature coefficient tests were made on several of the cells. An automatic zeroing circuit for a d-c amplifier was designed and constructed. The effects of electrode spacing, radiation intensity, and gas pressure were studied theoretically. (M.P.G.)

4227 AERE-C/R-1524
Atomic Energy Research Establishment, Harwell, Berks (England)
SOME REMARKS ON THE GUINIER-TYPE X-RAY

FOCUSING CAMERA. R. W. M. D'Eye. Oct. 9, 1954. 14p.

The Guinier-type focusing camera and the method of setting up and adjustments are described. Some results showing its use for indexing powder diffraction data are given. (auth)

4228 D-14839
Boeing Airplane Co.
INSTALLATION PROCEDURE FOR BONDED TYPE RESISTANCE WIRE STRAIN GAGES. Jan. 25, 1954. 40p.

Detailed procedures are presented for the installation of bonded resistance wire strain gages. Safety precautions, selection of gages, surface preparation, and cleaning, testing, electrical connection, gage protection, and inspection procedures are discussed. (J.E.D.)

4229 DP-112
DuPont de Nemours, E. I., and Co. Explosives Dept. Atomic Energy Div.
A VERSATILE LABORATORY SERVO-AMPLIFIER. L. M. Johnson. Mar. 1955. 11p. Contract AT(07-2)-1.

A versatile amplifier was developed for use as a laboratory instrument in the design of various electrical servo systems. (auth)

4230 HE-150-124
Institute of Engineering Research, Univ. of Calif., Berkeley
FLUID FLOW AND HEAT TRANSFER AT LOW PRESSURES AND TEMPERATURE. DESIGN OF A TWO COMPONENT MICROBALANCE FOR LOW DENSITY WIND TUNNELS. R. N. Latz. Aug. 10, 1954. 51p. Contract N7-onr-295.

The balance meets the design requirements of measuring lift and drag to 0.1 mg, has a minimum variation in model displacement from null during the force measurements, and has remote observation and control. (auth)

4231 RDB-(W)/TN-197
Research and Development Branch, Industrial Group, Windscale Works, United Kingdom Atomic Energy Authority, Windscale, Cumb. (England)
A LIQUID METAL LEVEL INDICATOR. G. Bottomley. Mar. 1955. 12p.

Details are given of a level indicator suitable for use with liquid metals. A bifilar wound transformer is inserted into a stainless steel tube fitted along the axis of the tank containing the liquid metal. An alternating voltage across one winding produces an output voltage from the second winding which varies with the metal level. Over the range tested the instrument was found to be linear. A circuit diagram and list of components are included. (auth)

4232
A THEORY ON IMAGE FORMATION OF ELECTRON MICROSCOPE. Ryozi Uyeda (Nagoya Univ., Japan). *J. Phys. Soc. Japan* 10, 256-64(1955) Apr.

This article is presented to give a consistent basis to all theories of image formation of an electron microscope. The author's idea is to build up an image of a specimen from images of atoms which make up the specimen. The result obtained by developing this idea indicates that an actual image is composed of two ideal images, one of which shows phase contrast and the other contrast due to scattering absorption. By applying this result, bright and dark field images are explained. Not only images of amorphous specimens but those of crystalline specimens are treated. (auth)

4233

A HYDROGEN PIRANI LEAK DETECTOR USING A CHARCOAL TRAP. T. B. Kent (United Kingdom Atomic Energy Authority, Capenhurst Works, Chester, England). *J. Sci. Instr.* 32, 132-4(1955) Apr.

A simple robust dynamic leak detector suitable for vacuum proving large numbers of components is described. The property of charcoal at low temperatures to absorb a large percentage of atmospheric gases and little hydrogen is used to eliminate irregular pressure pulses caused by impurities in the component and to increase the response of a Pirani gage when a leak is probed with hydrogen. A charcoal trap is placed between the component and a Pirani gage on a vacuum unit. (auth)

ISOTOPES

4234 NYO-3934-II

Massachusetts Inst. of Tech.

INVESTIGATIONS OF ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM, AND ARGON IN CERTAIN MINERALS, AND RELATED TOPICS. ANNUAL PROGRESS REPORT FOR 1953-4. PART II. VARIATIONS IN ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM, AND ARGON AND RELATED TOPICS. ANNUAL RESEARCH PROGRESS REPORT. Leonard F. Herzog, William H. Pinson, Jr., Milo M. Backus, Lawrence Strickland, and Patrick M. Hurley. Apr. 30, 1954. 165p. Contract AT(30-1)-1381.

ISOTOPE SEPARATION

4235 JENER-35

Joint Establishment for Nuclear Energy Research (Norway) A NEW METHOD FOR EXTRACTION OF RADIOACTIVE PHOSPHORUS-32. K. Samsahl and K. Taugbøl. 1955. 8p.

The principle of separating an isotope formed from the solid target material by diffusion, by utilizing a crystal change of the target, is applied to the preparation of radioactive P^{32} . Irradiated, finely powdered sulphur is boiled with water containing a few drops of a suitable wetting agent. Owing to the transition point between rhombic and monoclinic sulphur at 95.5°C, the radioactive phosphorus will diffuse out of the solid material in 1 to 2 hours, and thus be extracted into the water. The yields depend greatly on the particle size of the sulphur, giving above 80% for finely ground material. Radiochemical analysis showed that the solution contained no other activities than phosphorus. Radioactive S^{35} thus remains in the target material. Spectrographic analysis showed a very pure product; no iron could be detected. The method requires only about 3 hours and the apparatus is very simple. It thus represents a convenient method for routine preparation of P^{32} from pile irradiated sulphur. This method will therefore be adopted for the routine production of this isotope at JENER. (auth)

MASS SPECTROGRAPHY

4236 PDB-95 and Add.

Chalk River Project (Canada)

A BIBLIOGRAPHY OF MASS SPECTROMETRY REFERENCES. Oct. 15, 1953. 170p. (AECL-146)

Results of a literature search through 1947 are presented. References are included on theory, electronics, measuring devices, analytical data and techniques, and isotopes and relative abundance. 659 references. (C.W.H.)

MATHEMATICS

4237 ANL-5368

Argonne National Lab.

DESIGN OF A COMPUTER—ORACLE. J. C. Chu. Sept. 1954. 127p. Contract W-31-109-eng-38.

4238 IMM-NYU-216

Institute of Mathematical Sciences, New York Univ.

LECTURES ON THE THEORY OF INDUSTRIAL SAMPLING. TECHNICAL REPORT NO. IV. J. H. Curtiss. Apr.

1955. 152p. Contracts DA-30-069-ORD-1257 and N6ori-201, T. O. 1.

These lectures were given to graduate students at New York University during the fall term of the academic year 1953-54. The aim of the course was to discuss the theory and rationale of modern industrial sampling procedures. Although specific cases were discussed at some length in the latter part of the lectures, this was done with a view to clarifying the theory, rather than to providing the students with an engineer's manual of quality control methods. (auth)

4239 NP-5618

Laboratory of Molecular Structure and Spectra, Univ. of Chicago

TABLES OF TWO-CENTER COULOMB INTEGRALS BETWEEN 1s, 2s, AND 2p ORBITALS. C. C. J. Roothaan. 1955. 53p. Contract N6ORI-20, T. O. 9.

4240 ORNL-1876

Oak Ridge National Lab.

DIFFERENTIAL SYSTEMS WITH INTERFACE CONDITIONS. Frank W. Stallard. Apr. 28, 1955. 74p. Contract W-7405-eng-26.

This paper establishes that differential systems with interface conditions may be studied by investigating an associated system without such conditions, where the matrices involved in each system have the same dimension. The association gives a one to one correspondence between the discontinuous solutions of the interface problem and the absolutely continuous solutions of the associated system. As a consequence of this correspondence, one has that theoretical results for boundary-value problems with absolutely continuous solutions imply corresponding results for associated interface problems. Among the results established by this method are existence and uniqueness of the solutions, the Green's matrix and its properties, and adjoint and self-adjoint relationships. A formula is developed for finding the general solution of homogeneous systems with interface conditions. It does not depend upon the specific form of the interface conditions, hence one may treat conditions that require some, all, or none of the elements of the solution matrix Y to be continuous at the interface in exactly the same manner. The effectiveness of this approach is illustrated by solving a steady state, n -region, one substance diffusion problem and a characteristic value, or eigenvalue problem for a n -region, two substance diffusion problem. These examples also serve to illustrate that the results of this paper have applications to the composite boundary value problems of heat conduction, chemical diffusion, potential theory, vibration theory and nuclear reactor theory. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

4241 AD-7151

Distillation Products Industries, Rochester

EVALUATION STUDIES OF COLORIMETRIC AND

CONDUCTIMETRIC DOSIMETERS. MONTHLY PROGRESS REPORT NO. 12. M. E. Johnson, J. C. Swartz, and A. R. Hamilton. Apr. 15, 1953. 3p. Contract DA 18-108-CML-3617.

Experiments on chloroform and tetrachloroethylene indicate that there is no difference in the radiation sensitivities of the 2 liquids when irradiated pure or in the presence of the other. Color vs. dose characteristics of 3 dye-tetrachloroethylene solutions are presented. (M.P.G.)

4242 AD-7152

Distillation Products Industries, Rochester
EVALUATION STUDIES OF COLORIMETRIC AND CONDUCTIMETRIC DOSIMETERS. FINAL REPORT. Apr. 15, 1953. 9p. Contract DA 18-108-CML-3617.

Chloroform-water (conductimetric) and chloroform-dye (colorimetric) dosimeters have been studied for sensitivity, stability, dose-rate dependence, and after reaction. The final models of the 2 dosimeters possess practically the same sensitivity. Both are usable in the range 50 to 600r. The radiation reaction in chloroform was investigated. (M.P.G.)

4243 AD-11745

Polaroid Corp.
RADIACMETER IM-56()/PD. INTERIM DEVELOPMENT. REPORT NO. 7. [FOR] JANUARY 1, 1952 TO MARCH 31, 1952. C. F. Valle, Jr. July 7, 1952. 19p. Contract NObsr-49193.

A pilot plant was designed for sensitizing about 100 KBr crystals per run. Of several integrating bar-type dosimeters, the type 85 covering a 0- to 400-r range in 4 steps appeared the most satisfactory. The device exhibited good stability, sensitivity, and resistance to moisture penetration; however, colors of the 3-dimensional crystal and the target were difficult to match because of the depth effect in the crystal which could not be produced by the 2-dimensional comparison strip. Sensitized KBr crystals had U-center concentration of 5×10^{18} /cc or greater. A 10-hr exposure to ordinary light at room temperature was required to reduce the apparent dose from 400 to 200 r; the dose decreased to 100 r in an additional 10 hrs. (ASTIA abst.)

4244 AERE-C/R-1534

Atomic Energy Research Establishment, Harwell, Berks (England)
IMPROVED METHODS FOR THE ROUTINE RADIO-CHEMICAL ANALYSIS OF FISSION PRODUCT MIXTURES. PART I. THE RECOGNITION OF RADIOCHEMICAL PURITY USING ALUMINIUM ABSORPTION CURVES. G. Phillips and E. N. Jenkins. Oct. 21, 1954. 20p.

Results of a study on methods for the analysis of mixed fission products for an individual radioelement show that the Automatic Absorber/Sampler Changer Type 112A may be used to obtain reproducible aluminum absorption curves under fixed conditions of source weight, mounting, and geometry. The reproducibility is maintained with successive sources, Geiger tubes, and Automatic Absorber Changers. A library of standard absorption curves is presented for many of the common fission products mounted on 30 mg of carrier precipitate and spread over a deep aluminum tray. (auth)

4245 UCRL-2579(Rev.)

Radiation Lab., Univ. of Calif., Berkeley
EMULSION TABLES. I. HEAVY-PARTICLE FUNCTIONS.

Walter H. Barkas and D. M. Young. Sept. 1954. 23p. Contract W-7405-eng-48.

The measurable features of charged-particle tracks in emulsion are analyzed with regard to their functional dependence on the particle mass, charge, and velocity. Each quantity is then normalized by the appropriate function of the mass and charge so that it becomes a function of velocity alone. A numerical table is constructed in which each such quantity is given as a function of velocity and thus related to all the others. The entries in the table may be interpreted directly for protons, but by virtue of its method of construction, the table applies to all charged particles that are massive compared to an electron. It is supplemented by interpolation indices for rapid utilization. A table of mass equivalents for elementary particles and light nuclei is included, as well as information concerning the emulsion composition and density. (auth)

4246 UCRL-4465

Radiation Lab., Univ. of Calif., Livermore
SUGGESTED USES OF CYCLOIDAL-TRAJECTORY PARTICLE SPECTROMETERS IN NUCLEAR RESEARCH. Peter C. Stevenson. Mar. 9, 1955. 16p. Contract W-7405-eng-48.

The motion of a charged particle in a region of crossed electric and magnetic fields is discussed. Motion in the plane perpendicular to the magnetic field is cycloidal and has useful focusing properties. Possible applications of such a system to various problems in nuclear research are suggested. It is shown to be possible, in principle, to measure the kinetic energy, mass, and ionic charge of various nuclear-reaction products and to separate various short-lived products for rapid examination. Two different devices are proposed. The application of the technique to investigation of the fission process is specifically discussed. (auth)

4247 WAL-844/18

Watertown Arsenal Lab.
THE DESIGN OF A BETA-RAY SPECTROMETER. Roger P. Vancour and Alfred J. Moses. Dec. 1, 1954. 21p.

A beta-ray spectrometer has been designed for simultaneous counting of positive and negative electrons and for rough determinations of the energy distribution of these particles. The spectrometer will detect particles having a minimum energy of 0.16 Mev; a particle of mean energy of 0.7 Mev can be counted. (auth)

4248 AEC-tr-2123

LUMINESCENT CHAMBER. E. K. Zavoiskii, G. E. Smolkin, A. G. Plakov, and M. M. Butslav. Translated by Luke C. L. Yuan from *Doklady Akad. Nauk S.S.S.R.* 100, 241-2(1955). 5p.

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 9-2860.

4249

A MODIFIED POCKET INTEGRATING ION CHAMBER TYPE B.D.11 OF NEARLY UNIFORM POLAR RESPONSE. B. W. Soole (Admiralty Research Lab., Teddington, Middlesex, England). *J. Sci. Instr.* 32, 144-5(1955) Apr.

The pocket ionization chamber type B.D.11 as developed by the Medical Research Council for personnel protection is shown to be less sensitive to γ radiation received along its axis than to radiation received in a perpendicular direction. By reducing the over-all length of the chamber from 46.5 to 32.5 mm the chamber may be made equally sensitive

in all directions, excepting that along its axis through the screw. (auth)

4250

RANGE-ENERGY RELATION OF TRITON IN THE NUCLEAR EMULSION UP TO 10 MEV. Mitsuo Miwa and Katsumi Kuriyama (Tokyo Univ. of Education). *J. Phys. Soc. Japan* **10**, 320-1(1955) Apr.

4251

BRITISH NUCLEONIC INSTRUMENTATION. III. A. SURVEY. *Atomics* **6**, 83-5(1955) Mar.

The latest radiation detection instruments developed by the British industries are discussed. Among the instruments described are a clinical monitor for general purposes and an automatic frequency monitor. (C.W.H.)

4252

A SIX GAP β -RAY SPECTROMETER. O. B. Nielsen and O. Kofoed-Hansen. *Kgl. Danske Videnskab. Selkab. Mat.-fys. Medd.* **29**, No. 6, 1-19(1955). (In English)

A β spectrometer is described which is constructed according to a new principle. A transmission of 9 % is obtained at a resolution of 1.6 %. The instrument is especially well suited for coincidence investigations with scintillation counters. Some of the properties of the spectrometer are discussed from a practical point of view. A few new applications for the focusing principle are suggested. (auth)

MESONS

4253 NEVIS-7

Nevis Cyclotron Labs., Columbia Univ.

A DIFFUSION CLOUD CHAMBER STUDY OF VERY SLOW MESONS. II. BETA DECAY OF THE MUON. C. P. Sargent, M. Rinehart, L. M. Lederman, and K. C. Rogers. Mar. 1955. 26p. Sponsored by ONR and AEC under Contract N6-ori-110-Task No. 1. (CU-80-55-ONR-110-1-Phys.)

The spectrum of electrons arising from the decay of the negative μ meson has been determined. The muons are arrested in the gas of a high-pressure hydrogen-filled diffusion cloud chamber. The momenta of the decay electrons are determined from their curvature in a magnetic field of 7750 gauss. The spectrum of 415 electrons has been analyzed according to the theory of Michel. The shape parameter, ρ , is found to be $0.64 \pm .10$. The significance of this result in terms of the β interaction is discussed. (auth)

4254 NEVIS-8

Nevis Cyclotron Labs., Columbia Univ.

SEARCH FOR THE β -DECAY OF THE PION. S. Lokanathan and J. Steinberger. Mar. 1955. 25p. Sponsored by ONR and AEC under contract N6-ori-110, T. O. 1. (CU-81-55-ONR-110-1-Phys.)

An attempt has been made to find the β decay of the pion. It was found that the ratio $\pi^+ \rightarrow e^+ + \nu/\pi^+ \rightarrow \mu^+ + \nu = (-.3 \pm .9) \times 10^{-4}$. It is concluded that it is improbable that β decay accounts for more than 1 in 16,000 π decays. In an appendix, the results of some Monte Carlo calculations which were employed in the analysis of the experiment are presented. These calculations give the ranges of electrons with energy near the critical energy. (auth)

4255

EXAMPLE OF τ^+ -DECAY IN FLIGHT. J. R. Burwell, R. W. Huggett, and R. W. Thompson (Indiana Univ., Bloomington). *Phys. Rev.* **98**, 101-2(1955) Apr. 1.

A τ^+ meson, of 0.83 Bev/c, is observed to undergo normal

decay in flight with $Q(3\pi) = 73.9 \pm 5.8$ Mev. The center-of-mass kinetic energies are found to be $T' = 24.3 \pm 1.8$ and 28.7 ± 1.8 Mev for the two positive pions and $T' = 20.9 \pm 4.3$ Mev for the negative pion. (auth)

4256

PION-PAIR PRODUCTION IN A NUCLEAR EMULSION. Herman Yagoda (National Institutes of Health, Bethesda, Md.). *Phys. Rev.* **98**, 103-4(1955) Apr. 1.

A positive and a negative π -meson pair of tracks with energies of 17.94 and 18.65 Mev, respectively, are observed to originate in an emulsion without any other associated ionizing particles. It is shown that the event probably did not originate from a nuclear collision. Among the mechanisms considered are materialization from a photon, the decay of a theta-meson, and decay of a (previously postulated) zeta meson. The Q -value of the event, computed as a 2-body decay is 27.9 Mev. If it is a two-body decay the mass of the parent particle is about 600 mc. This event is also consistent with the decay of a neutral tau meson into a neutral pion and two charged pions for which the total kinetic energy of the charged mesons could vary between 0 and about 80 Mev. (auth)

4257

PRODUCTION OF HEAVY UNSTABLE PARTICLES BY 1.37-BEV PIONS. W. B. Fowler, R. P. Shutt, A. M. Thorndike, and W. L. Whittemore (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **98**, 121-30(1955) Apr. 1.

Five additional events interpreted as the production of heavy unstable particles by 1.37-Bev pions have been observed in a hydrogen-filled diffusion cloud chamber. In each case the observations are most naturally interpreted as due to the associated production of a hyperon and K meson. These and earlier observations can be made consistent with known hyperon and K meson masses if the reaction $\pi^- + p \rightarrow \Sigma^0 + \theta^0$ is assumed to be a possibility with an immediate γ -decay $\Sigma^0 \rightarrow \Lambda^0 + \gamma$ as suggested by Gell-Mann and Pais. The total cross section for production of heavy unstable particles is estimated to be about 0.9 mb. The five new events confirm the previous indications that the Λ^0 's tend to be emitted backwards in the center-of-mass system of the initial collision and to decay in a plane at a small angle to that of the production plane. The orientations of Λ^0 's from the wall also support these angular correlations. (auth)

4258

PHOTOPRODUCTION OF π^+ MESONS FROM HYDROGEN NEAR THRESHOLD. J. E. Leiss, C. S. Robinson, and S. Penner (Univ. of Illinois, Urbana). *Phys. Rev.* **98**, 201-2(1955) Apr. 1.

The total cross section for photoproduction of π^+ mesons very close to threshold was investigated, following the method of a preliminary experiment (*Phys. Rev.* **95**, 638(A) (1954)). (auth)

4259

ANGULAR DISTRIBUTIONS OF PIONS FROM θ^0 DECAY. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **98**, 205-6(1955) Apr. 1.

The expected angular distribution between the π^+ and π^- mesons as a function of the kinetic energy of the θ^0 is calculated, the derivation following closely that given by Rossi (High Energy Particles (Prentice-Hall, Inc., New York (1952), pp. 192, 198)). (L.M.T.)

4260

LOW-ENERGY PHOTOPRODUCTION OF π^0 MESONS FROM

HYDROGEN: TOTAL CROSS SECTION. F. E. Mills and L. J. Koester, Jr. (Univ. of Illinois, Urbana). Phys. Rev. **98**, 210-11(1955) Apr. 1.

Total cross sections for the photoproduction of neutral pions from threshold to 240 Mev were measured with the use of a liquid H target. One of the π^0 decay photons was detected in a scintillation counter telescope composed of an anticoincidence counter, a $1/4$ -in. Pb converter, and two counters in coincidence separated by a $1/2$ -in. thick Al absorber. (auth)

4261

LOW-ENERGY PHOTOPRODUCTION OF π^0 MESONS IN HYDROGEN: DIFFERENTIAL CROSS SECTIONS AT 135°.

Louis J. Koester, Jr. (Univ. of Illinois, Urbana). Phys. Rev. **98**, 211-12(1955) Apr. 1.

Differential cross sections for the reaction $h\nu + p \rightarrow \pi^0 + p$ were measured for incident energies between 180 and 215 mev by observation of the recoil protons. (auth)

4262

CAPTURE OF NEGATIVE K MESONS. J. Hornbostel and E. O. Salant (Brookhaven National Lab., Upton, N. Y.).

Phys. Rev. **98**, 218-19(1955) Apr. 1.

Search for K^- mesons was continued with essentially the same arrangement previously described (Phys. Rev. **93**, 902(1954)), but with 2.8-Bev protons. The stack of stripped emulsions receives a collimated beam of negative particles of momentum 316 Mev/c emitted from a Be target at 4° to the proton beam. Each emulsion was scanned, near its edge through which the beam entered, for tracks of the beam direction and of about twice minimum grain density, appropriate to the K mesons. All such tracks were then followed to their ends. In this way, 13 stars made by K^- mesons at the end of their range were found. A complete analysis of the results is presented. (L.M.T.)

METEOROLOGY

4263

THE ARGONNE EXPERIMENTAL METEOROLOGY STACK.

Glenn R. Hilst and Harry Moses (Argonne National Lab., Lemont, Ill.). Bull. Am. Meteorol. Soc. **36**, 31-2(1955) Jan.

Design requirements of the experimental meteorology stack built at the Argonne National Laboratory for use in studies on the behavior of stack effluents include variable stack height, variable effluent exit speeds, controllable effluent tracer concentrations, and portability of the stack assembly. The general arrangement of the component parts of the stack installation and the motor blower arrangement for the stack are described. (C.H.)

MICROWAVES

4264 NP-5596

Institute for the Study of Rate Processes, Univ. of Utah
THE MEASUREMENT OF DETONATION VELOCITY BY MICROWAVE RESONATOR TECHNIQUES. TECHNICAL REPORT NO. XLIV. E. F. Pound. Mar. 7, 1955. 25p. Contract N7-onr-45107.

The use of microwave electromagnetic radiation as a tool to measure the detonation velocity of explosives is described. The method makes use of the ionized wave front of the detonation as a reflector to form a resonant cavity or transmission line. One cycle of electrical impedance change corresponds to a change in length of $1/2$ wave length of the guided electromagnetic wave; hence the detonation

velocity can be measured. Three types of electromagnetic wave guides were used; first, the explosive charge was covered with aluminum foil to form a metallic wave guide; second, the explosive charge was used as a dielectric wave guide; and third, a coaxial cable, as the active part of the doppler system, was placed in or on the explosive charge. The relative merits of each method are discussed in the report. (auth)

NEUTRONS

4265 AERE-T/M-117

Atomic Energy Research Establishment, Harwell, Berks (England)

THE ABSORPTION OF NEUTRONS BY A SMALL, STRONGLY ABSORBING ROD. R. J. Royston. Nov. 1954. 8p.

The flux of neutrons inside a small rod of strongly absorbing, nonscattering material is calculated on the assumption that the incident flux of neutrons is isotropic. (auth)

NUCLEAR PHYSICS

4266 ISC-577

Ames Lab.

QUARTERLY SUMMARY RESEARCH REPORT IN PHYSICS FOR OCTOBER, NOVEMBER, AND DECEMBER 1954. Apr. 12, 1955. 13p. Contract W-7405-eng-82.

The ionization yield of 50- to 250-kev ions in various gases has been measured. Results for protons in N are given. Ionization produced by the particles from the reaction $B^{10}(n, \alpha) Li^7$ has been measured in A, $A + CO_2$, and $A + N_2$. The addition of a molecular impurity to A appears to reduce the relative ionization for low-velocity particles. Improvements in the techniques for measuring the β spectra from short-lived nuclei have resulted in more accurate values for the endpoints of S^{31} and Ca^{39} . Preliminary measurements have been made of the thermal conductivity of Zr. Semiconducting metallic compounds, Cu_2Se and Mg_2Si , have been prepared, and their electric properties are being studied. The work function for the 001 face of cleaved Zn crystals was found to be 4.1 ± 0.2 v. (For preceding period see ISC-533.) (M.P.G.)

4267

SHELL THEORY FOR THE NUCLEI WITH MASS 19. Martin G. Redlich (Univ. of Wisconsin, Madison). Phys. Rev. **98**, 199-200(1955) Apr. 1.

Calculations for the nuclei with $A = 19$ have been made on the basis of a shell model with a harmonic oscillator central potential to represent the O^{16} core, central Gaussian interactions between pairs of outer nucleons, and energy differences between $1d_{3/2}$, $2s_{1/2}$, and $1d_{5/2}$ single-particle levels equal to the ones observed for levels with these spins and parity + in O^{17} . The model and all parameters save one are the ones which have been used in previous calculations for $A = 18$. One parameter, the depth of the two-nucleon potential, $-V_0$, will later be changed from the value 70.8 Mev, which, for the range used, gives the correct H^2 binding energy. (auth)

4268

NUCLEAR SURFACE ENERGY AND THE DIFFUSENESS OF THE NUCLEAR SURFACE. W. J. Swiatecki (Inst. for Mechanics and Mathematical Physics and Gustaf Werner Inst. for Nuclear Chemistry, Uppsala, Sweden). Phys. Rev. **98**, 203-4(1955) Apr. 1.

In the course of an attempt to interpret the empirical magnitude of the nuclear surface energy $S(4\pi R_0^2 S = 15 \text{ Mev}$, $R_0 = 1.4 \times 10^{-13} \text{ cm}$), reasons were found to indicate that this quantity is intimately related to the diffuseness of the nuclear surface and should in fact provide a measure of the thickness of the surface region. (auth)

4269

AVERAGE NUCLEAR POTENTIALS AND DENSITIES. W. J. Swiatecki (Inst. for Mechanics and Mathematical Physics and Gustaf Werner Inst. for Nuclear Chemistry, Uppsala, Sweden). *Phys. Rev.* **98**, 204-5(1955) Apr. 1.

In the preceding letter (see preceding abstract) the empirical magnitude of the nuclear surface energy, interpreted on the basis of the individual particle model, suggests a nuclear potential well with rather gently sloping sides. This note discusses some consequences of such a potential. (auth)

4270

SYSTEM OF EVEN-EVEN NUCLEI. Gertrude Scharff-Goldhaber and J. Weneser (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **98**, 212-14(1955) Apr. 1.

The second excited states of even-even nuclei in the region $36 \leq N \leq 88$ have been studied in more detail, and the results are discussed. (L.M.T.)

4271

NUCLEAR PHYSICS. Irving Kaplan (Brookhaven National Lab., Upton, N. Y.). Cambridge, Addison-Wesley Publishing Co., Inc., 1955. 609p.

This elementary account of nuclear physics is intended to introduce readers with no previous experience in atomic or nuclear physics to the field. No mathematics beyond differential and integral calculus is involved, and the book will probably be of greatest use in advanced undergraduate physics courses or to those interested in large scale applications to "nuclear engineering." (L.M.T.)

NUCLEAR PROPERTIES

4272

NUCLEAR SPIN OF URANIUM-235. K. L. Vander Sluis and J. R. McNally, Jr. (Oak Ridge National Lab., Tenn.). *J. Opt. Soc. Amer.* **45**, 65-6(1955) Jan.

Fabry-Perot interferograms of ~ 150 hyperfine structure patterns were taken in the region 4000 to 8800 Å. The intensity analysis conclusively yields the spin value $7/2$ and reveals the existence of an unresolved doublet in the pattern. (L.M.T.)

4273

THE BINDING ENERGIES OF ^3H AND ^4He . G. Abraham, L. Cohen, and A. S. Roberts (Univ. of Manchester, England). *Proc. Phys. Soc. (London)* **A68**, 265-84(1955) Apr.

The binding energies of H^3 and He^4 are calculated as part of an attempt to solve the consistency problem of light nuclei. A phenomenological two-body interaction, with central and tensor forces of different range, is assumed, the parameters being taken from a recent paper by Feshbach and Schwinger. The inclusion of additional sets of D-states in the wave functions is found to have a very appreciable effect on the binding energies. A rough calculation shows that the contribution of spin-orbit forces may not be negligible. Without a more extensive investigation into the effects of the additional D-states and the effect of spin-orbit forces, it is impossible to conclude that the interaction used leads to a satisfactory solution of the consistency problem. (auth)

4274

ON THE 113-KEV LEVEL OF Lu^{175} . Nadine Marty. *Compt. rend.* **240**, 963-5(1955) Feb. 28. (In French)

The relative intensity of 282- and 396-keV photons arising from the β disintegration of Yb^{175} was investigated, and found to be $I_{282}/I_{396} = 0.58 \pm 0.05$. An intense γ radiation of 113-keV was found in coincidence with 282-keV photon radiation. The γ ray has a conversion coefficient $\alpha_K = 2.35 \pm 0.4$, and is an M_1 or $M_1 + E_2$ mixture corresponding to the 113-keV level obtained by Coulomb excitation of Lu^{175} . (tr-auth)

4275

EXCITATION BY COULOMB INTERACTION IN THALLIUM. Roland Barloutaud, Tovy Grjebine, and Michel Riou. *Compt. rend.* **240**, 1207-10(1955) Mar. 14. (In French)

The Coulomb excitation of $\text{Tl}^{203, 205}$ by protons was used to observe γ radiation of 205, 280, and 410 keV. Thick target excitation curves and absolute cross sections were determined. (tr-auth)

4276

Cl^{35} PURE QUADRUPOLE RESONANCES IN ACID CHLORIDES AND CHLORATES. P. J. Bray (Rensselaer Polytechnic Inst., Troy, N. Y.). *J. Chem. Phys.* **23**, 703-6(1955) Apr.

The pure quadrupole resonances of Cl^{35} in acid chlorides of some aliphatic dicarboxylic acids have been observed. No resonances have been found in acid chlorides of aliphatic monocarboxylic acids which retain the unsubstituted CH_3 configuration at the chain end not occupied by the COCl group. This absence of resonances is attributed to possible randomness in the crystal structure of thermally activated low-frequency reorientations of groups within the molecule. Resonances have also been measured in several chlorates, sulfuryl chloride, iodine monochloride, iodine trichloride, and selenium tetrachloride. Structural and bonding discussions are given for the latter two compounds. (auth)

4277

THE DETERMINATION OF THE ELECTRIC QUADRUPOLE MOMENTS OF THE ISOTOPES Rb^{85} AND Rb^{87} BY MEASUREMENT OF HIGH-FREQUENCY TRANSITION IN $6^2\text{P}_{3/2}$ -TERM OF THE Rb ATOM. Hubert Krüger and Ulrich Meyer-Berkhout (Univ. of Heidelberg, Germany). *Naturwissenschaften* **42**, 94-5(1955) Feb. (In German).

4278

NUCLEAR MAGNETIC MOMENTS OF La^{139} . Gerold Lührs and Andreas Steudel (Univ. of Heidelberg, Germany). *Naturwissenschaften* **42**, 120(1955) Mar. (In German)

4279

HYPERFINE STRUCTURE OF He^{3+} AND He^3 . A. M. Sessler and H. M. Foley (Columbia Univ., New York). *Phys. Rev.* **98**, 6-18(1955) Apr. 1.

The ratio of the hfs of He^{3+} to H^1 is calculated by taking into account all effects other than the radiative mass corrections, α/m (hfs), which contribute a relative correction to hfs greater than 10^{-6} . This includes the effect of nuclear structure and internal motion, and also of interaction currents calculated according to various models. Following A. Bohr, structure effects are calculated in the adiabatic approximation, and corrections for nonadiabaticity are included. Nuclear orbital hfs is evaluated by a perturbation theory which proceeds from a nonadiabatic approximation, and a rather simple general expression is obtained for the evaluation of the effect of interaction currents. Corrections are obtained to the hfs

of the He^3S atomic state, as calculated with a non-relativistic wave function for a point nucleus of infinite mass. These corrections include both the nuclear structure effects for which the analysis of He^{3+} applies, and the relativistic and reduced mass effects characteristic of the two-electron atom. (auth)

4280

HALF-LIFE OF Rb^{86} . James B. Niday (Univ. of California Radiation Lab., Livermore). *Phys. Rev.* **98**, 42(1955) Apr. 1.

A number of very pure samples of Rb^{86} obtained by a new radiochemical procedure were found to have a half life of 18.64 ± 0.04 days. (auth)

4281

(n,2n) CROSS SECTION OF Na^{23} AT 14.1 MEV. R. J. Prestwood (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **98**, 47-9(1955) Apr. 1.

An experimental determination of this cross section was made on six individual samples and involved the use of 4π counting, low background counting, neutron monitoring, and sample thickness corrections. The value obtained is 13.8 ± 2.2 mb and the error quoted is twice the standard deviation obtained from the six samples. The experimental work is described in detail and a discussion of the possible errors is given. (auth)

4282

SPINS AND PARITIES OF EXCITED STATES OF Ce^{140} AND Sr^{88} . G. R. Bishop and J. P. Perez Y Jorba (Clarendon Lab., Oxford, England). *Phys. Rev.* **98**, 89-94 (1955) Apr. 1.

The angular correlations and the direction-polarization correlations of γ rays of Ce^{140} and Sr^{88} have been measured. Spins and parities have been assigned to the excited states of these nuclei as follows. Ce^{140} : 2.42 Mev, 3^- ; 2.09 Mev, 4^+ ; 1.60 Mev, 2^+ . Sr^{88} : 2.78 Mev, 3^- ; 1.87 Mev, 2^+ . (auth)

4283

SPIN POLARIZATION OF THE DEUTERON. W. Lakin (Carnegie Inst. of Tech., Pittsburgh, Penna.). *Phys. Rev.* **98**, 139-44(1955) Apr. 1.

Methods of specifying the state of polarization of a particle of spin 1 are discussed. Selection rules for polarization effects in simple nuclear reactions are derived; in general four parameters are needed to describe the deuteron polarization due to such reactions. Methods of determining these parameters include the use of magnetic deflection. A rough analysis is made of the polarization of deuterons scattered by carbon. (auth)

4284

SPIN AND LIFETIME OF THE 439-KEV EXCITED STATE OF Hg^{202} . Franz R. Metzger (Franklin Inst., Swarthmore, Penna.). *Phys. Rev.* **98**, 200-1(1955) Apr. 1.

Nuclear resonance fluorescence from the 439-kev excited state of Hg^{202} was observed from using a source of Tl^{202} at 1000°C . Angular distribution measurements of the resonance radiation confirm the assignment of spin 2 to this level. A lifetime of $(3.4 \pm 0.7) \times 10^{-11}$ sec was calculated. (L.M.T.)

NUCLEAR REACTORS

4285 NAA-SR-Memo-707

North American Aviation, Inc.

EFFECTIVENESS OF CONTROL ROD IN LIGHT WATER MODERATED REACTOR. R[alph] Balent. May 29, 1953. 9p. Contract [AT-11-1-GEN-8].

An expression for the excess multiplication which can be taken up by a control rod, derived by Glasstone and Edlund using asymptotic expressions for Bessel functions with small arguments, is modified for the case of highly absorbing water-moderated reactors where asymptotic expressions for the Bessel functions are not valid. The resulting equation is worked out numerically for a control rod 2 cm in radius. (K.S.)

NUCLEAR TRANSFORMATION

4286 UCRL-4371

Radiation Lab., Univ. of Calif., Livermore

THE REACTION $\text{Al}^{27}(\text{p}, 3\text{pn})\text{Na}^{24}$. P. C. Stevenson, H. G. Hicks, and R. L. Folger. Aug. 11, 1954. 6p. Contract W-7405-eng-48.

The cross section for the reaction $\text{Al}^{27}(\text{p}, 3\text{pn})\text{Na}^{24}$ has been measured for proton energies between 30 and 350 Mev relative to the cross section for the reaction $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$. The absolute magnitude of the cross section was determined by matching with data measured with a Faraday cup at 350 Mev and at 31.5 Mev. (auth)

4287 AEC-tr-2127

KINETIC ANALYSIS OF CHAIN REACTIONS. I. KINETICS OF CHAIN REACTIONS OCCURRING WITH THE PARTICIPATION OF ONE TYPE OF INTERMEDIATE ACTIVE PARTICLES. S. S. Vasil'yev. Translated from *Zhur. Fiz. Khim.* **26**, 1024-35(1952). 27p.

An abstract of this appears in *Nuclear Science Abstracts* as NSA 9-3605.

4288

EXCITATION FUNCTIONS FOR SOME PROTON-INDUCED REACTIONS OF THORIUM. Howard A. Tewes (California Research and Development Co., Livermore). *Phys. Rev.* **98**, 25-7(1955) Apr. 1.

The excitation functions for the (p, η), (p,n), and (p,3n) reactions on thorium have been determined for proton energies up to 32 Mev. (auth)

4289

GAMMA-RAYS FROM THE DEUTERON BOMBARDMENT OF CARBON-13. R. J. Mackin, Jr., W. B. Mims, and W. R. Mills, Jr. (California Inst. of Tech., Pasadena). *Phys. Rev.* **98**, 43-6(1955) Apr. 1.

A magnetic lens spectrometer was used to investigate the γ radiation produced by the deuteron bombardment of C^{13} enriched carbon targets. A study of the Compton electron spectra from a thin Al converter at $E_d = 1.42$ Mev revealed the following γ lines (energies in kev, not corrected for possible Doppler shift): 4930 ± 40 , 5130 ± 30 , 5730 ± 30 , 6120 ± 25 . A weak line at 3910 ± 50 kev was established with the spectrum from a thick Al converter. At $E_d = 1.9$ Mev, additional lines appeared at 6450 ± 50 , 6730 ± 40 , and 811 ± 3 kev. The last-named was identified by photoelectrons from a thorium converter. No new lines were discovered at $E_d = 2.7$ Mev. The well-known 6.12-Mev line is from C^{14*} , as are probably the 6.73- and 0.811-Mev lines. All others correspond to known levels of N^{14} . (auth)

4290

ANGULAR DISTRIBUTIONS AND YIELDS OF NEUTRONS FROM (p,n) REACTIONS. Bernard L. Cohen (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **98**, 49-55(1955) Apr. 1.

Angular distributions of neutrons from (p,n) reactions on Mg, Al, Cu, Mo, Ag, Ta, Au, Th, and U were measured for 23-Mev protons incident on thick targets. All angular

distributions show peaks in the forward direction; except for Mg and Al, the $0^\circ/180^\circ$ intensity ratios vary from 5 to 15 for ~ 13 -Mev neutrons, and from 1.3 to 5 for ~ 8 -Mev neutrons. The Mg and Al high-energy data show minima and secondary maxima. Yield determinations indicate that the number of neutrons per nuclear reaction increases with atomic number from about 0.25 for Mg and Al to about 2.0 for most heavy elements and more than 4 for Th and U (probably due to fission). Temperatures of the neutron energy distributions are estimated; for the heavy elements at the backward angles, they are about 0.85 Mev at 3-Mev neutron energy, and about 1.9 Mev at 10-Mev neutron energy. It is concluded that direct interactions are of considerable importance in these reactions. (auth)

4291

REACTION $D(t,\alpha)n$ AT 1.5 MEV. A. Hemmendinger and H. V. Argo (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* 98, 70-2(1955) Apr. 1.

The differential cross section for the reaction $D(t,\alpha)n$ has been measured at 10° intervals from 10 to 140° in the laboratory system for a triton energy of 1.5 Mev. The total cross section is 280 ± 8 mb. (auth)

4292

ABSOLUTE CROSS SECTION FOR THE REACTION $C^{12}(\gamma,n)C^{11}$. W. C. Barber, W. D. George, and D. D. Reagan (Stanford Univ., Calif.). *Phys. Rev.* 98, 73-6(1955) Apr. 1.

The activation curve for the reaction $C^{12}(\gamma,n)C^{11}$ was obtained with the use of both the Mark II (38-Mev) and Mark III (630-Mev) linear accelerators, covering the energy range 18 to 260 Mev. Stacked foils of polystyrene detectors and tantalum and copper radiators were exposed to the direct electron beam and the resulting C^{11} activity was measured with a 4π scintillation counter. The photon flux was obtained from the measured electron flux by means of the Bethe-Heitler theory of bremsstrahlung, and the photon-difference method was applied to obtain the cross-section curve. This curve was found to be similar to some previous results, but with the addition of a high-energy tail extending beyond 38 Mev. The experimental accuracy does not permit a precise determination of the shape of this tail, but it cannot be accounted for by mesonic effects alone. The cross section has a peak value of about 8.3 millibarns at 22.5 Mev, and integrated values of 0.056 ± 0.003 and about 0.080 ± 0.01 Mev-barns when the integrals are carried up to 38 and 250 Mev, respectively. These numerical values were obtained from the data obtained by using a copper radiator. The corresponding results with a tantalum radiator are about 7 % lower, indicating a possible failure of the bremsstrahlung formula for high atomic numbers. (auth)

4293

ANGULAR DISTRIBUTION OF DISINTEGRATION PRODUCTS FROM THE $O^{16}(d,p)O^{17}$, $Be^9(d,p)Be^{10}$, AND $Be^9(d,t)Be^8$ REACTIONS. Mira K. Jurić (Institute of Nuclear Sciences "Boris Kidrich," Belgrade, Yugoslavia). *Phys. Rev.* 98, 85-8(1955) Apr. 1.

The angular distributions of disintegration products from the reactions $O^{16}(d,p)O^{17}$, $Be^9(d,p)Be^{10}$, and $Be^9(d,t)Be^8$ were examined, with deuteron energies from 0.60 to 1.45 Mev. Pronounced asymmetry is found with respect to 90° . The results are analyzed to determine the relative contributions of stripping and compound nucleus formation. (auth)

4294

PHOTODISINTEGRATION OF CARBON-12 BY 330-MEV

BREMSSTRAHLUNG. Sheldon D. Softky (Univ. of California, Berkeley). *Phys. Rev.* 98, 173(1955) Apr. 1.

The excitation function for the reaction $C^{12}(\gamma,3\alpha)$ from 330-Mev bremsstrahlung has been measured. Ilford C2 600 μ emulsions were irradiated and scanned for three-prong stars which satisfied conservation of momentum for the disintegration. Of the forty-six stars found, none were from quanta bigger than 42 Mev and so an upper limit for the cross section was estimated up to 100 Mev. From this it can be seen that there are no prominent resonances up to 100 Mev other than those already known. (auth)

PARTICLE ACCÉLÉRATORS

4295 CERN-PS/ER-41

[European Organization for Nuclear Research, Geneva] ON THE DESIGN OF POLE FACE WINDINGS. E. Regenstreif. Mar. 1955. 9p.

Assimilating the gap of the electromagnet to a magnetic wedge structure, the field and field gradient due to uniform density current sheets placed on the magnet pole faces can be calculated. Compensation of n departures by means of pole windings is then considered. (auth)

4296 CERN-PS/MM-10

[European Organization for Nuclear Research, Geneva] AIMANT AC III. (Magnet AC III). Jan. 1955. 22p.

Variations in the median plane of the CERN model AC-III magnet were investigated, and found to be less than 0.3 mm. Leakage fluxes were measured at the equilibrium orbit at field strengths of 9000 to 15,000 gauss. Other measurements are reported on the residual field of the magnet, the effect of measuring coils on the field and field gradient, and the magnetic characteristics of the Fe used as the magnet material. (K.S.)

4297 CERN-PS/MM-11

[European Organization for Nuclear Research, Geneva] MODELE AC III. (Model AC III). Jan. 1955. 39p.

Results of a previous series of reports on the AC-III magnet design of the CERN proton synchrotron (CERN-PS/MM 1 to CERN-PS/MM 10) are summarized in condensed form. Construction of the magnet is described, together with measurement techniques, and a summary of important results. (K.S.)

4298 CERN-PS/RGb-7

[European Organization for Nuclear Research, Geneva] DISCUSSION DES METHODES UTILISABLES EXPERIMENTALEMENT POUR VERIFIER L'EXACTITUDE DE LA FREQUENCE D'ACCELERATION DU SYNCHROTRON A PROTONS. (Discussion of Experimentally Useful Methods for Verifying the Exactness of the Acceleration Frequency of a Proton Synchrotron). R. Gabillard. [nd] (Includes appendixes I through III). 71p.

RADIATION ABSORPTION AND SCATTERING

4299 AD-38860

Computation Lab., Wayne Univ. RESEARCH ON THE SIZE AND SHAPE OF LARGE MOLECULES AND COLLOIDAL PARTICLES. TECHNICAL REPORT NO. 9. TABLES OF SCATTERING FUNCTIONS FOR SPHERICAL COLLOIDAL PARTICLES III. ($\alpha = 8.0(1.0)15.0$; $M = (1.05, 1.10, 1.30)$). W. Heller. Aug. 15, 1954. 14p. Contract Nonr. 736(000).

4300 UCRL-4379

Radiation Lab., Univ. of Calif., Livermore
ENERGY-DEPENDENT ALBEDO. William E. Drummond.
 Sept. 20, 1954. 10p. Contract W-7405-eng-48.

Within the framework of age theory an expression is developed which represents the probability of a neutron being reflected with an energy loss corresponding to age, τ , as a function of reflector thickness. In particular, for the case of an infinite reflector the solution reduced to $P(\tau) = 1/D\sqrt{\pi\tau} - \exp(\tau/4D^2)\text{erfc}(\sqrt{\tau}/2D)$. (auth)

4301

ELASTIC SCATTERING OF 9.76-MEV PROTONS BY HELIUM. John H. Williams and Stanley W. Rasmussen (Univ. of Minnesota, Minneapolis). *Phys. Rev.* **98**, 56-7 (1955) Apr. 1.

The differential cross section for elastic scattering of 9.76-Mev protons by He has been investigated over the range of center-of-mass angles from 43° to 174° . The results are in essential agreement with those of Putnam at 9.48 Mev, differ from those by Freemantle et al. at 9.55 Mev by a constant factor, but do not confirm those of Cork and Hartsough at 9.7 Mev. (auth)

4302

CORRECTION TO THE EXPONENTIAL DEPENDENCE OF NEUTRON TRANSMISSIONS. R. G. Thomas (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **98**, 77-8 (1955) Apr. 1.

If the energy spread of the neutron source used in a transmission type of measurement of total neutron cross sections is large compared with the mean spacing of the resonance levels of the sample, these levels may effect a deviation from the simple exponential dependence on sample thickness. The correction to this dependence is derived in the case where capture, inelastic scattering, and Doppler broadening may be neglected. The derivation does not depend upon any special assumption regarding the distributions of the widths and spacings of the levels other than that they have suitable averages, and the correction is found to be proportional to the ratio of these averages, as one would expect. It is noted that by measurement of this ratio for certain elements, it may be possible to distinguish between the predictions of the strong-coupling and complex square-well representations of the neutron-nucleus interaction. (auth)

4303

MEASUREMENT OF THE SCATTERING CONSTANT IN NUCLEAR EMULSION. Lyle W. Smith (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **98**, 100 (1955) Apr. 1.

The general solution to the diffusion equation is used to show that a measurement of track-to-track scattering of identical particles yields a value of the scattering constant in an unambiguous manner. (auth)

4304

SCATTERING OF POLARIZED NUCLEON BEAMS. Reinhard Oehme (Univ. of Chicago, Ill.). *Phys. Rev.* **98**, 147-53 (1955) Apr. 1.

The polarization formulas for the general reaction $a + b \rightarrow c + d$ are given in a compact form and specialized for the scattering of polarized nucleon beams at unpolarized targets. These targets may have arbitrary spin, possibly being different before and after collision. An interesting quantity in this problem is the polarization of the scattered nucleon beam. On the basis of general invariance properties of the

transition matrix, this polarization is expressed by the polarization of the incoming nucleon beam and the relative momenta before and after collision. The invariant coefficients in this relation are functions of energy and scattering angle only; they are given in terms of the parameters of the transition matrix. By using these formulas, it is shown that with triple scattering experiments one can obtain two new relations between the parameters of the transition matrix at fixed energy and angle. Quadruple scattering leads to two further relations. These relations represent information in addition to the differential cross section and the polarization resulting from unpolarized beams. The results are specialized for targets of spin zero and spin one-half, where in the latter case also the scattering of identical particles is discussed briefly. (auth)

4305

SCATTERING OF 192-MEV ELECTRONS FROM THE DEUTERON. John A. McIntyre and Robert Hofstadter (Stanford Univ., Calif.). *Phys. Rev.* **98**, 158-61 (1955) Apr. 1.

Elastic scattering of 192-Mev electrons from deuterium has been studied using both solid (CD_2) and high-pressure gas targets. The results obtained by these two methods are in agreement and yield the following conclusions: (1) The range of the neutron-proton potential is between 1 and 4×10^{-13} cm if a square potential well is assumed and if the deuteron wave functions predicted by the binding energy of the deuteron are used. (2) It is, however, impossible with the present data to eliminate the possibility of other charge distributions for deuterium such as uniform or Gaussian. Inelastic electron scattering from deuterium was also investigated, and promises to give independent information of the deuteron structure. (auth)

4306

RELATION BETWEEN MULTIPLE COULOMB SCATTERING AND RESIDUAL RANGE IN NUCLEAR EMULSION. R. G. Glasser (Univ. of Chicago, Ill.). *Phys. Rev.* **98**, 174-80 (1955) Apr. 1.

Measurements of multiple Coulomb scattering were carried out on 101 artificially produced stopping protons from the end of the track to a point where the residual range was 2500μ . These measurements yield a new relation between range and multiple scattering which can be represented by a power law. The mass dependence was derived theoretically and checked by measuring 20 positive pions. The general relationship is:

$$\langle |\eta| \rangle_{AV} = (19.0 \pm 0.3) R^{-(0.607 \pm 0.016)} (M_p/M)^{(0.393 \pm 0.016)} (t/50)^{1/2},$$

where $\langle |\eta| \rangle_{AV}$ is the mean absolute sagitta due to multiple scattering, R is the range, t the cell length, M is the particle mass, and M_p the mass of the proton. All lengths are measured in microns. This relationship leads to a set of schemes for making scattering measurements on stopping tracks in order to determine the mass of the particle with the maximal efficiency. The precision possible on an individual track is limited, but a sequence of tracks, each of which need not be too long, can give a very satisfactory precision, free from the systematic errors inherent in ionization measurements. (auth)

4307

ANGULAR DISTRIBUTION OF PICKUP DEUTERONS FOR 95-MEV PROTONS ON CARBON, AND IMPLICATIONS AS TO INTERNAL INTERACTIONS IN CARBON. W. Selove

(Harvard Univ., Cambridge, Mass.). Phys. Rev. **98**, 208-10 (1955) Apr. 1.

The angular distribution of the sharp-energy group of deuterons observed in this reaction has been analyzed by Born-approximation pickup theory, to give the internal momentum distribution of the picked-up neutrons. The momentum distribution shows relatively strong high-momentum components, and these in turn indicate the presence of a strong short-range interaction in carbon. (auth)

4308

POSSIBLE EXPERIMENTS TO DETERMINE THE TRANSITION MATRIX FOR p - p SCATTERING. Reinhard Oehme (Univ. of Chicago, Ill.). Phys. Rev. **98**, 216-17(1955) Apr. 1.

Recently, it became possible to perform scattering experiments with polarized proton beams on unpolarized hydrogen targets. (Ypsilantis et al., Am. Phys. Soc. **29**, No. 8, 19 (1954)). This note points out that for given energy and scattering angle one may obtain up to eleven independent relations between the parameters of the p - p transition matrix, provided it is experimentally possible to perform all necessary single, double, and triple scattering experiments. The targets are always unpolarized and only one hydrogen scattering is necessary. (auth)

4309

ELECTRON SCATTERING FROM THE PROTON. Robert Hofstadter and Robert W. McAllister (Stanford Univ., Calif.). Phys. Rev. **98**, 217-18(1955) Apr. 1.

The elastic scattering of electrons of energies 100, 186, and 236 Mev from protons initially at rest was studied with apparatus previously described (Phys. Rev. **92**, 978(1953); **95**, 512(1954)). At 100 and 188 Mev, the angular distributions were examined in the ranges 60 to 138° and 35 to 138°, respectively. At 236 Mev, because of the inability of the analyzing magnet to bend electrons of energies >192 Mev, the range 90 to 138° was used. A plot shows the experimental curve, the Mott curve, and the point-charge, point-magnetic-moment curve. (L.M.T.)

4310

AN INVESTIGATION OF THE LONGITUDINAL ANGULAR DISTRIBUTION OF PHOTOELECTRONS AT GAMMA RAY ENERGIES OF 0.41, 0.66 AND 1.33 MEV. Sölve Hultberg. Arkiv Fysik **9**, No. 3, 245-80(1955). (In English)

The longitudinal angular intensity distributions of K-shell photoelectrons from different radiators at the gamma ray energies 0.41 Mev (Au^{198}), 0.66 Mev (Cs^{137}) and 1.33 Mev (Co^{60}) have been studied. The distribution functions $J(\vartheta)$ are referred to $\vartheta = 0$ as direction of incidence of the quanta. ϑ is the longitudinal angle in a polar coordinate system ϑ, ϕ, r . The recorded photo-lines are shown and the angular distributions are obtained by plotting the photo-line peak heights versus ϑ . In order to get the true distributions the experimental curves are corrected for geometrical distortion and multiple scattering in the converter (Molière's theory is used). From the true distributions the preferred directions of emission ϑ_{max} of the photo-electrons were accurately determined. (auth)

4311

POLARIZATION OF NEUTRONS IN HIGH ENERGY SCATTERING. T. Eriksson and W. J. Swiatecki. Arkiv Fysik **9**, No. 3, 281-6(1955). (In English)

Results of calculations made with the object of learning about the type of polarization effects to be expected in the elastic scattering of neutrons by a heavy nucleus are presented. The polarization was assumed to be due to a spin-

orbit coupling of a magnitude suggested by the shell model. The nucleus was represented by a spherical, complex, square-well potential with spin-orbit coupling. (L.M.T.)

4312

THE ANGULAR CORRELATION OF ANNIHILATION RADIATION. K. L. Erdman (Univ. of British Columbia, Vancouver, Canada). Proc. Phys. Soc. (London) **A68**, 204-11 (1955) Apr.

The departure from exact 180° angular correlation of quanta resulting from positrons annihilating in various materials has been measured. This provides data as to the momenta of the centres of mass of the annihilating electron-positron pairs. It does not appear possible to account for the data on the assumption that the positron achieves thermal energy by lattice collisions before annihilating, so that such measurements may not be simply related to the momentum distribution of the more loosely bound electrons in the absorbing substance. (auth)

4313

THE MEAN FREE PATH OF SLOW NEUTRONS IN NUCLEAR MATTER. C. B. O. Mohr (Univ. of Melbourne, Australia). Proc. Phys. Soc. (London) **A68**, 340-1(1955) Apr.

The variation of scattering length for slow neutrons as a function of nuclear radius, for mass numbers near 150, is obtained for different values of ξ which specifies the nuclear absorption, and for two forms of potential well. (L.M.T.)

RADIATION EFFECTS

4314 AERE-Lib/Trans-459

DISCOLORATION AND LUMINESCENCE CAUSED BY BECQUEREL V RAYS AND ASSOCIATED PHENOMENA. K. Przibram. Translated by E. R. Hollely from Z. Physik **130**, 269-92(1951)

An abstract of this paper appears in Nuclear Science Abstracts as NSA 6-142.

4315

RADIATION INDUCED COLOUR CENTRES IN FUSED QUARTZ. M. Levy and J. H. O. Varley (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Phys. Soc. (London) **B68**, 223-33(1955) Apr.

Samples of fused quartz ('Vitreosil') have been irradiated by pile, gamma or x rays and three absorption bands are produced with maxima at 2.3, 4.1, and approximately 5.6 ev. It is suggested that the 2.3 ev band is due to sodium borate impurities in the glass. All three bands can be bleached either optically or thermally or, more rapidly, by a combination of both processes. An empirical law describing the thermal bleaching rate of the 2.3-ev band over a large range of n is $dn/dt = -Ae^{bn}$ where n is number of color centers per cm^3 at time t ; A, b are constants. Bleaching of the 2.3 ev and 4.1 ev bands can also be brought about by large doses of pile irradiation. This is attributed to vacancies caused by atomic displacements combining with electron traps to produce new centers. These latter are assumed to give an absorption outside the range of observation in these experiments, viz. 6.2 ev to 1.2 ev. (auth)

4316

FLUORESCENT BEHAVIOR OF SOLUTIONS CONTAINING MORE THAN ONE SOLVENT. Milton Furst and Hartmut Kallmann (New York Univ., N. Y.). J. Chem. Phys. **23**, 607-12(1955) Apr.

Fluorescent emission of organic solutions in combinations of solvents is investigated in order to determine the reasons for the suitability or unsuitability of solvents for high-energy induced fluorescence, particularly where these solvents do not influence the emission under ultraviolet irradiation. Basically two types of behavior under high-energy radiation are found in these combined solvent solutions. In type I a considerable drop in emitted intensity occurs only when the amount of the "poor" solvent greatly exceeds that of the "effective" solvent, whereas in type II small amounts of added "poor" solvent produce large decreases in emitted intensity. The fluorescence depends upon the concentration of solute, larger concentrations giving greater light outputs. The results obtained are explained by assuming that energy transfer occurs from the "poor" solvent to the "effective" one. At the same time a decrease in actual lifetime of excitation in the "effective" solvent occurs which is induced by the presence of the "poor" solvent molecules. This shows up as a quenching of the gamma-ray induced fluorescence in solutions even with solutes which are scarcely quenched at all under ultraviolet light excitation. For type I behavior this quenching is small while for type II it is considerable. (auth)

4317

EXPERIMENTAL STUDY OF THE MECHANISM OF THERMOLUMINESCENCE IN IRRADIATED SODIUM CHLORIDE. J. J. Hill and P. Schwed (Lewis Flight Propulsion Lab., Cleveland, Ohio). *J. Chem. Phys.* **23**, 652-8(1955) Apr.

The general configuration of the emission spectrum of synthetic NaCl crystals which had been irradiated with 7×10^5 r of x rays at room temperature and were then permitted to luminesce at 500°K was determined, and bands were located with maxima at 362, 418, and 525 millimicrons. The glow curves for NaCl crystals irradiated with x rays or ultraviolet light were investigated, and eight bursts of light (glow peaks) were found with peaks at temperatures between 334 and 625°K. The relative contribution of the different bursts to the total glow curve was determined as a function of the amount of x-ray irradiation. The activation energies for five of the bursts were measured and in each case turned out to be about 1.25 ev. It is suggested that these results indicate that the thermoluminescence takes place by means of a two-stage process of the following sort. The first stage, which is the same for all the bursts and is thermally activated with the measured activation energy, takes place when trapped electrons are raised from F-centers into the conduction band. In the second stage, electrons in the conduction band fall into different empty energy levels, there being one type of level for each burst. The large observed differences between the peak temperatures of the different bursts is then due to large variations in the probabilities of this second process for different levels. (auth)

RADIOACTIVITY

4318 NP-5612

Pennsylvania Univ.

ANGULAR CORRELATION MEASUREMENTS IN Sn^{117}

R. Golden and S. Frankel. Apr. 15, 1955. 48p. Contract DA-36-034-ORD-1351. Technical Report No. 2.

The decay of the nuclear isomer, Sn^{117} , occurs in two steps in the form $h\ 11/2 \rightarrow d\ 3/2 \rightarrow s\ 1/2$. The angular correlation between the K converted electron from the

159-keV γ in the first transition and the 162-keV γ in the second transition, was obtained with a thin lens beta spectrometer and a γ detector. Geometrical corrections for the finite size of source and detectors were made and the correlation obtained in the form $W(\theta) = 1 + A_2 P_2(\cos \theta)$. The measured value of the K electron-gamma angular correlation coefficient, extrapolated to a wipeout factor of 1, is 0.136. This gives a mixture ratio of E2 radiation to E2 + M1 radiation, in the second transition, of 0.15%. The phase factor is 0. (auth)

4319

GAMMA RAYS OF 100^{254} . Frank Asaro, Frank S. Stephens, Jr., S. G. Thompson, and I. Perlman (Univ. of Calif., Berkeley). *Phys. Rev.* **98**, 19-21(1955) Apr. 1.

Gamma rays of 42 ± 4 ($2 \times 10^{-2}\%$) and 94 ± 2 keV ($2.8 \times 10^{-2}\%$) were found in coincidence with alpha particles of 100^{254} . The L x rays (from the internal conversion of the 42-keV γ ray) were measured and from the intensity the population of the first excited state was calculated to be $15 \pm 2\%$. The γ rays are interpreted as cascading transitions resulting from the de-excitation of Bohr-Mottelson rotational states having spins of 2 and 4, even parity. The abundances of the alpha transitions to the spin 4 states of even-even nuclides in this region (after normalizing for differences in energy separation from the ground state) exhibit a pronounced minimum for curium emitters and progressively increase for emitters of higher and lower atomic number. (auth)

4320

ALPHA AND GAMMA SPECTRA OF Cf^{246} . J. P. Hummel, Frank S. Stephens, Jr., Frank Asaro, A. Chetham-Strode, Jr., and I. Perlman (Univ. of California, Berkeley). *Phys. Rev.* **98**, 22-3(1955) Apr. 1.

The α and γ spectra of Cf^{246} have been studied with an α particle spectrograph and γ -ray scintillation spectrometer. Alpha groups of 6.753 MeV (78%) and 6.711 MeV (22%) were observed. L x rays and gamma rays of ~ 100 keV ($1.4 \times 10^{-2}\%$) and ~ 44 keV were assigned to Cf^{246} . These results are evaluated with respect to the developing theory and systematics of complex α spectra and excited states of even-even nuclei. (auth)

4321

THEOREM ON ANGULAR CORRELATION. S. Raboy and V. E. Krohn (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **98**, 24-5(1955) Apr. 1.

In a multiple cascade, the angular correlations between a γ ray and each of two following or preceding γ rays are shown to be equal for the following conditions: (1) The two observed γ rays not common to both pairs must have the same multipolarity and must result from basic transitions. (2) If the two observed γ rays not common to both pairs have unobserved γ rays between them, these unobserved γ rays must come from basic transitions. (3) The transitions subject to the first two conditions must take place between levels with spins in monotonic sequence. (auth)

4322

DECAY OF THE 3.5-MIN METASTABLE STATE OF Sb^{122} . J. M. LeBlanc, J. M. Cork, and S. B. Burson (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **98**, 39-40(1955) Apr. 1.

The radiations associated with the 3.5-min activity of Sb^{122} have been studied with 180° magnetic photographic spectrometers and a ten-channel coincidence scintillation spectrometer. Two γ rays with energies of 60.7 and 75.3

kev were detected by means of internal conversion electrons and also by means of the scintillation spectrometer. The 75.3-kev transition is the more strongly converted of the two, and it is concluded that it is the isomeric transition. The two γ rays are emitted in cascade. (auth)

4323

REDETERMINATION OF THE DISINTEGRATION CONSTANT OF U^{238} . A. F. Kovarik and N. I. Adams, Jr. (Yale Univ., New Haven, Conn.). *Phys. Rev.* **98**, 46(1955) Apr. 1.

A recount of alpha particles from previously used specimens of natural uranium gives $1.538 \times 10^{-10} \text{ yr}^{-1}$ for the disintegration constant of U^{238} . (auth)

4324

DECAY OF Y^{91} . B. Kahn and W. S. Lyon (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **98**, 58-9(1955) Apr. 1.

Yttrium-91 was observed to decay with a half life of 57.5 ± 0.5 days. In addition to the 1.55-Mev β transitions, $0.22 \pm 0.01\%$ of the Y^{91} decay consists of a 0.36 ± 0.02 -Mev β group in coincidence with a 1.190 ± 0.005 -Mev γ ray. (auth)

4325

ISOTOPIC SPIN SELECTION RULE FOR ELECTRIC DIPOLE TRANSITIONS. William M. MacDonald (Princeton Univ., N. J.). *Phys. Rev.* **98**, 60-5(1955) Apr. 1.

The validity of the isotopic spin quantum number in nuclei provides a selection rule on electric dipole transitions. The extent to which this selection rule is violated provides a means of experimentally determining the isotopic spin impurity of nuclear states providing that the radiation widths for uninhibited E1 radiation can be predicted. The sources of possible variations of E1 matrix elements are discussed with reference to the reliability of predicted E1 radiation widths in nuclei for $A \leq 20$ and excitation energy ~ 15 Mev. Higher order corrections to the E1 selection rules are determined and found to be negligible compared to the effects of isotopic spin impurity. It is concluded that the isotopic spin selection rule on E1 transitions provides a sensitive test of charge independence. Isotopic spin impurity determined in this way can be attributed solely to the Coulomb potential. (auth)

4326

RADIOACTIVITY OF Co^{57} . Bernd Crasemann and D. L. Manley (Univ. of Oregon, Eugene). *Phys. Rev.* **98**, 66-8(1955) Apr. 1.

Co^{57} (270-day) has been prepared by the reactions $Mn^{55}(\alpha, 2n)$ and $Ni^{58}(p, 2p)$, separated chemically, and its disintegration studied with a magnetic lens and a scintillation spectrometer. Co^{57} decays by electron capture; an upper limit of 2×10^{-5} positron per disintegration has been set. Positron groups previously assigned to Co^{57} presumably belong to one of the neighboring isotopes of cobalt. Gamma rays of 0.137 and 0.123 Mev have a relative abundance of 7 and 93%, and presumably are E2 and M1 transitions, respectively. A decay scheme is outlined. (auth)

4327

PHOTODISINTEGRATION OF THE DEUTERON. Y. Yamaguchi and Y. Yamaguchi (Univ. of Illinois, Urbana). *Phys. Rev.* **98**, 69-70(1955) Apr. 1.

The electric dipole cross section for $\gamma(d, p)n$ is examined, assuming no forces in 3P states. The non-

vanishing D-state probability P_D of deuteron gives rise to the isotropic part a_e in angular distribution of the photo-proton: $d\sigma/d\omega = a_e + b_e \sin^2\theta$. It turns out, however, that the resulting value for a_e is still small to explain the experimental cross section, even if P_D is as large as 8%. (auth)

4328

RADIATIONS OF Mo^{90} AND THE ISOMERIC STATES OF Nb^{90} . Hirdaya B. Mathur and Earl K. Hyde (Univ. of California, Berkeley). *Phys. Rev.* **98**, 79-84(1955) Apr. 1.

Gamma-gamma coincidence measurements of the radiations of 5.7-hour Mo^{90} showed that the 120- and 250-kev γ rays previously reported by Diamond were delayed. Further experiments showed the existence of a 24-second isomer of Nb^{90} emitting 120-kev γ rays and a 10 to 20 millisecond isomer emitting 250-kev γ rays. The transition types were not assigned unambiguously but the 24-second isomer is probably E2 and the 10 to 20 msec isomer E3 or M3 in nature. The radiations of the 14.6-hour ground state of Nb^{90} were also studied. The 140-kev and 1.14-Mev γ rays are in coincidence with each other and with annihilation radiation. A prominent 2.2-Mev γ ray is not in coincidence with annihilation radiation or x rays. Hence, it must be a delayed transition with $\Delta I \geq 3$. This is of interest because of the rarity of such transitions in even-even nuclei. (auth)

4329

IRIDIUM-194. C. E. Mandeville, Jagdish Varma, and Babulal Saraf (Franklin Inst., Swarthmore, Penna.). *Phys. Rev.* **98**, 94-9(1955) Apr. 1.

Electromagnetically enriched quantities of Ir^{193} were exposed for time intervals ranging from 0.5 to 2.0 hr on five successive occasions in the Brookhaven pile. The 19-hour Ir^{194} was found to emit gamma rays of energies 0.295, 0.325, 0.635, 0.640, 0.93, 1.14, 1.28, 1.45, 1.58, 1.77, and ~ 2.00 Mev. By coincidence studies, cascade relationships were established between ten pairs of gamma rays. The first and second excited states of the residual nucleus were located at 325 and 620 kev. The angular correlation function of the 0.295 Mev-0.325 Mev cascade was measured and found to correspond to a $2 \rightarrow 2 \rightarrow 0$ distribution, thus giving the spins of the first two excited states of Pt^{194} . (auth)

4330

FIRST-FORBIDDEN NONUNIQUE BETA SPECTRA in Re^{186} . F. T. Porter, M. S. Freedman, T. B. Novey, and F. Wagner, Jr. (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **98**, 214-15(1955) Apr. 1.

The anomaly of the isotropic β - γ angular correlation and the apparent β shape of the first inner β group in Re^{186} led the authors to examine the β spectrum in coincidence with the 137-kev γ . When the observed coincidence spectrum was subtracted from the singles spectrum, normalizing so as to secure $E_0 = 1073$ kev ($936 + 137$), the resultant ground-state curve showed a shape similar to the inner group and a relative abundance of $78 \pm 2\%$. The only spin assignment for Re^{186} consistent with the similar f values and shapes for the two prominent β branches and with the small but definite β - γ angular anisotropy is $1-$, in agreement with Koerts (*Phys. Rev.* **95**, 1358(1954)), who found, however, an allowed shape for the inner group in coincidence. The results, together with the cases of RaE and Sb^{124} , confirm the existence of first-forbidden nonunique spectral shapes. (L.M.T.)

4331

A NOTE ON MEAN LIFE-TIME DETERMINATIONS ON

SMALL SAMPLES OF RADIOACTIVE NUCLEI. G. Ekspong. *Arkiv Fysik* 9, No. 3, 353-5(1955). (In English)

Peierls (*Proc. Roy. Soc. A*149, 467(1935)) used statistical methods for deriving a general relation for half lives when the sample is very small or the half life very long. This note draws attention to Peierls' relation, and presents the derivation in a more elementary way. (L.M.T.)

SPECTROSCOPY

4332 NP-5592

Duke Univ.

RADIOFREQUENCY SPECTROSCOPY. STATUS AND TECHNICAL REPORT NO. 11 (FOR THE PERIOD) NOVEMBER 1, 1954-FEBRUARY 1, 1955. 45p. Contract DA-36-034-ORD-1233.

A technical report is presented on nuclear quadrupole resonance (NQR) in solids. NQR is a branch of r-f spectroscopy concerned with magnetic resonance absorption in crystals. The absorption is due to reorientation of non-spherical atomic nuclei against crystalline electric fields. Motion and energy eigenvalues are derived for a system consisting of a nonspherical nucleus in a diatomic molecule forming part of a molecular crystal, e.g. one Cl nucleus in solid Cl₂. The experimental techniques for bringing about and detecting transitions between energy levels are described. NQR experiments provide information on the shape and density of the electron cloud in the neighborhood of a single nucleus and on the state of bonding of the atom. The class of dipole-less molecules which exhibits no rotational spectra, comprising highly symmetrical and all element molecules, is well suited for study by NQR. Data obtained from NQR experiments are presented for all atoms investigated by this method. Abstracts are included of papers entitled "Paramagnetic Resonance of Irradiated Hydrogen Sulfide and Hydrazine Chloride at Liquid Air Temperature" and "Paramagnetic Resonance of X-Irradiated Teflon." (M.P.G.)

4333 NP-5615

Norman Bridge Lab. of Physics, Calif. Inst. of Tech. BETA-RAY SPECTROSCOPY. FINAL REPORT [FOR] APRIL 1, 1953 TO APRIL 30, 1955. Herbert E. Henrikson. 40p. Contract DA-04-495-Ord-444.

The design and construction of the beta spectrometer are described. L subshell conversion coefficients were determined for several isotopes. Energy levels are presented for W¹⁸³, Pt¹⁹², and Os¹⁹². Additional spectral data are presented for Ce¹⁴⁴, Bi²⁰⁷, and Be⁷. (C.W.H.)

4334

ISOTOPE SHIFT IN Cd II λ 4415. Kiyoshi Murakawa (Institute of Science and Technology, Tokyo). *J. Phys. Soc. Japan* 10, 319-20(1955) Apr.

THEORETICAL PHYSICS

4335

LOWER LIMIT FOR THE ENERGY DERIVATIVE OF THE SCATTERING PHASE SHIFT. Eugene P. Wigner (Princeton Univ., N. J.). *Phys. Rev.* 98, 145-7(1955) Apr. 1.

It is shown that the derivative of the scattering phase shift with respect to energy, $d\eta/dE$, must exceed a certain limit if the interaction of scattered particle and scatterer vanishes beyond a certain distance. This limitation of $d\eta/dE$ is, naturally, a consequence of the principle of causality;

it is derived, however, from a property of the derivative matrix R. (auth)

4336

EQUIVALENT TWO-BODY METHOD FOR THE TRITON. Herman Feshbach and S. I. Rubinow (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* 98, 188-93(1955) Apr. 1.

A method for developing equivalent two-body problems for the binding energy of the triton has been derived from the variational principle. The method has been applied to two central-force problems. In the first, the exponential well of Rarita and Present is discussed and the method is shown to give excellent results. In the second, the central-force term in the Lévy potential including the repulsive core is investigated. It is estimated that the Lévy potential including the tensor term will give the correct order of binding energy to the triton. (auth)

4337

VARIATION CALCULATION OF THE POLARIZABILITY OF THE DEUTERON. B. W. Downs (Stanford Univ., Calif.). *Phys. Rev.* 98, 194-6(1955) Apr. 1.

The polarizability of the deuteron in a uniform electric field is calculated by a variation method. The result obtained by Ramsey, Malenka, and Kruse is rederived and improved in accuracy, and the modification of the deuteron wave function produced by the electric field is calculated. (auth)

4338

THE EFFECT OF A POTENTIAL GRADIENT ON THE DENSITY OF A DEGENERATE FERMI GAS. W. J. Swiatecki (Inst. for Mechanics and Mathematical Physics and The Gustaf Werner Inst. for Nuclear Chemistry, Upsala, Sweden). *Proc. Phys. Soc. (London)* A68, 285-93(1955) Apr.

By studying the properties of a degenerate gas in a linearly varying potential a modified relation is derived between density and potential which replaces the usual $p = \text{const. } V^{2/3}$, takes into account explicitly the presence of potential gradients, and can be used in regions of negative kinetic energy. When combined with Poisson's equation this gives a modified Thomas-Fermi differential equation. The resulting change in the density distribution of electrons in an atom is most marked in the outer regions, where the new equation leads to an $r^{-2} \exp(-r/a)$ decrease of density for a neutral atom. Applications to nuclear surface problems are mentioned. (auth)

4339

NOTE ON A SEARCH FOR SIMPLE ANALYTIC WAVE FUNCTIONS FOR CONFIGURATIONS $(1s)^2(2s)$ AND $(1s)^2(2s)^2$ IN ATOMS AND IONS FROM He TO C. E. Holðien (Blindern Universitet, Oslo, Norway). *Proc. Phys. Soc. (London)* A68, 297-303(1955) Apr.

Simple analytic expressions for the above configurations are derived, with one-electron functions (orbitals) being used in the construction of the complete wave function. (L.M.T.)

4340

THE EFFECT OF RADIATIVE CORRECTIONS ON A CHARGED SPIN $1/2$ PARTICLE IN A CONSTANT MAGNETIC FIELD. A. H. de Borde (Glasgow Univ., Scotland). *Proc. Phys. Soc. (London)* A68, 316-21(1955) Apr.

As an alternative approach to the problem of determining magnetic moments the S-matrix formalism for a Dirac particle in an electromagnetic field is re-expressed as an

integral equation of the Feynman type for a one-electron wave function. For a constant magnetic field, the equation reduces to a differential equation which may be solved for the energy eigenvalues in a nonrelativistic approximation with arbitrary radiative correction terms. Provided conditions resulting from gauge invariance are satisfied, application of charge renormalization shows that the cyclotron frequency is unaltered in all orders. The magnetic moment derived is the same as that derived direct from the S-matrix. (auth)

4341

ON THE IDENTIFICATION OF X-RAY SATELLITES. D. J. Candlin (Univ. of Birmingham, England). Proc. Phys. Soc. (London) **A68**, 322-8(1955) Apr.

The wave numbers of $K\alpha$ satellites from $Z = 19$ to $Z = 42$ are calculated with analytical wave functions, and the spectroscopic terms from which the observed lines are derived are identified. (auth)

URANIUM AND URANIUM COMPOUNDS

4342 NACA-RM-E-54L10

Lewis Flight Propulsion Lab., NACA

MEASURED EFFECTIVE THERMAL CONDUCTIVITY OF URANIUM OXIDE POWDER IN VARIOUS GASES AND GAS MIXTURES. J. S. Boegli and R. G. Deissler. [Dec. 10, 1954]. 21p.

Experimental effective conductivities of the gas- UO_2 powder mixtures were determined for He, A, and N_2 gases, and mixtures of He-A and Xe-Kr gases at temperatures between 200 and 1500°F. A method for determination of the relative thermal conductivity of the solid was devised from

knowledge of the effective conductivity of the powder and the conductivity of the gases used in the two-phase system. (C.W.H.)

4343

HIGH-ENERGY PROTON SPALLATION-FISSION OF URANIUM. R. L. Folger, P. C. Stevenson, and G. T. Seaborg (Univ. of California, Berkeley). Phys. Rev. **98**, 107-20(1955) Apr. 1.

The fission and spallation reactions produced in uranium by bombardment with high-energy protons (340 to 350 Mev) were investigated. The reaction products were separated from the target by chemical processes and identified by their radioactive properties. The relative yields of the observed fission products are calculated, and the results plotted as a function of mass number. Several of the spallation products are identified and their yields estimated. An attempt is made to determine the most probable atomic number for a nuclide of given mass formed directly from fission. Studies are made of the relative yields along several isobaric chains as a function of atomic number. From these data, estimates of the mass and charge of the fissioning nucleus are made. By using the reaction $Al^{27}(p,3pn)Na^{24}$ of known cross section to monitor the bombarding beam, the absolute formation cross sections for several fission product nuclides were measured. Values for these reference nuclides are used to transform all of the relative yields into formation cross sections. Summation integration over the range of mass numbers of the area under the plot of formation cross sections as a function of mass number leads to a value of 2.0 barns for the total fission cross section for uranium bombarded with high-energy protons, if one assumes binary fission. (auth)